STUDIES OF LUNG VOLUME.

II. Tuberculous Men.

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Hutchinson,[1] who invented the spirometer (1846), determined the vital capacity in twenty-two cases of early and nine cases of advanced pulmonary tuberculosis, and found that the vital capacity was subnormal in all. In the former group he found a decrease of from 10 to 50 per cent, in the latter of from 40 to 80 per cent. He calculated the normal figures from the height of the patient.[2] Since then numerous investigators, for example, Simon (1848), Wintrich (1854), Schneevoogt (1854),[3] Arnold (1855), Faivre (1864), Schönfeld (1882), and Hecht (1885), have confirmed this observation, and since von Ziemssen (1888) introduced his quotient[4] for the relation between height and vital capacity, spirometry has become practically a matter of routine in many clinics.

Despite the mass of data gathered, few attempts have been made to show which of the factors affecting the vital capacity are responsible for its decrease in tuberculosis.

Charlier studied the residual air in a group of patients with pulmonary tuberculosis and found it decreased. Siebeck examined the different lung volumes (total capacity, middle capacity, and residual air) in five patients and found the total capacity diminished, the middle capacity about normal, the residual air increased, and the vital capacity considerably diminished. However, the difficulty in establishing normal figures for a given pathologic case[5] made the de-

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[1] The mere title of Hutchinson's article shows how important he considered the determination of the vital capacity in patients. The title is, "On the capacity of the lungs, and on the respiratory functions, with a view of establishing a precise and easy method of detecting disease by the spirometer."

[2] For a detailed discussion see Lundsgaard and Van Slyke.

[3] Schneevoogt says: Tuberculosis of the lungs particularly will become apparent in this way before it can be diagnosed by any other means.

[4] Ziemssen's quotient is 1:20 in men and 1:17 in women. That means that 1 cm. of height corresponds to a vital capacity of 20 (17) cc.

[5] Siebeck says (p. 208): Not knowing the normal total capacity for a patient it is difficult to state anything about a deviation from the normal.

termination of absolute figures rather problematic. In other words, we do not know whether the decrease in the easily determinable vital capacity is caused by incomplete expiration (increased residual air) or by lessened inspiration (decreased total capacity). It is the purpose of the present paper partially to fill this lack in our present knowledge.

In a previous paper two of us (Lundsgaard and Van Slyke) have established evidence of a close relation between the dimensions of the chest and the capacity of the lungs in the three main positions,—maximum inspiration giving the total lung volume, rest half-way between a normal inspiration and expiration giving the middle capacity of the lungs, and maximum expiration leaving the residual air within the lungs. The ratios between the "chest volumes" and the lung volumes were worked out and found to be 55 for the total capacity, 37 for the middle capacity, and 19 for the residual air. The individual variations were within 10 per cent of these averages. Therefore, the chest volume multiplied by the factor thus determined gives the lung volume normal for a person of ascertained chest measurements.

The technique of determining the lung volumes and measuring the chest is fully described in Paper I. On the basis of our results there reported we have made an investigation of the lung volumes in 51 adult patients suffering from pulmonary tuberculosis. This paper is a report of our findings in 31 men. Our results in 20 women are reported in Paper III. The technique has been exactly as previously described. All the determinations were done with the patients in standing position. (1) The residual air was determined by the dilution method. As a rule, two determinations were done, and in some instances several. The lowest value was taken. (2) The vital capacity was then determined by expiration into a calibrated, easily movable Krogh spirometer. The expirations were continued until constancy was obtained. (3) The middle capacity was determined by normal breathing from the spirometer, which contained about 50 per cent oxygen, and the movements of the spirometer were recorded. When sufficient constancy appeared, the patient was asked to inspire and expire as much as possible, the vital capacity being controlled in this way. (4) If any doubt existed about the reliability of the experiments, a control was obtained by measuring the total capacity by the dilution method.

Having determined the lung volume, the chest measurements were taken in the three main positions, as previously described (Lundsgaard and Van Slyke). In a number the measurements were checked by two of us. Determinations of the movements of the diaphragm on a maximum respiration by means of x-ray (fluoroscopy) were then performed. The values were corrected (multiplied by 0.7) for parallax.

The other part of the investigation, the clinical examination of the patient, was completed within a few days after the lung and chest measurements. It consisted of (1) stethoscopic examination, (2) two x-ray plates, one taken from the front and one from the back, (3) determination of the influence of a certain amount of exercise on the pulse rate and respiration (Table I). The results are given on a chart for each case (Text-figs. 1 to 31). The different chest measurements are reported, because the relation between them gives some information about the form of chest in each particular case. The product of these measures is called chest volume, for the sake of convenience, although, of course, it is only approximately proportional to and not equal to the real chest volume. The lung capacities in the three main positions are given, and the ratios between the chest and lung volumes calculated. Besides this the ratio between the vital capacity and the middle chest volume is calculated, the normal ratio being 35 to 47. Two columns represent in diagrammatic form the calculated lung volume[6] and that actually found. The lowest (cross-hatched) part indicates the residual air, the rest is the vital capacity which is divided by a line indicating the upper limit of the middle capacity. The movements of the diaphragm are given in centimeters, and two lines indicate approximately the position of the midriff in maximum expiration and maximum inspiration. The stethoscopic and roentgenological findings are shown on four diagrams of the chest wall. The following symbols are used:

Physical Signs.—

Light lines, slight dullness.

Heavy lines, moderate dullness.

Cross-hatching, marked dullness.

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[6] The calculated lung volume means simply the chest volume multiplied by the (average) ratio for normal subjects which was established in Paper I.

Fine dots, fine râles.
Larger dots, moderate and coarse râles.
Small rings, large crackling râles.
Crosses, pleuritic rubs.
Circles, antrum formation.
There is no difference in the interpretation of horizontal and vertical lines.
X-Ray Signs.—
Lightly shaded lines, slight density of shadow.
Heavy lines, marked density.
Circles, cavity.
Dots, stippling, the larger the dots, the coarser the stippling.
There is no difference in the interpretation of horizontal and vertical lines.

A short description of each case is also given. The observations on the pulse and respiration before and after exercise are not given in the individual charts but are collected in Table I. In order to compare the findings from the different patients, the results are presented together in Text-figs. 32, 33, and 34, in the same way as the normal individuals were shown in a previous paper.[7]

It will be unnecessary to discuss each patient. We have therefore divided the patients into three groups according to the severity of the objective symptoms:[8] the incipient, the moderately advanced, and the advanced cases.

Patients with Incipient Tuberculosis.

Group I (Text-fig. 32) indicates nine patients (Nos. 1 to 9). The results in this group deviate appreciably but not greatly from the normal. The most conspicuous difference from the normal individuals is that the vital capacity[9] is moderately diminished in all but one case (No. 1). This is entirely due to an increase in the residual air. All the figures for the total capacity are within the normal limits; four below and five above the normal average. The residual air, on the other hand, is above the normal average in all but one

[7] See Text-fig. 6 of Paper I.

[8] We have followed the classification of The American Climatological Association which is based principally on Trudeau's scheme (cited in Rathbun, W. L., *Am. Rev. Tuberc.*, 1917, i, 13).

[9] See the ratio for the vital capacity on the individual charts (Text-figs. 1 to 31).

patient (No. 1). The middle capacity, which was determined in all but one patient, is not far from the normal limits. The results in this group (1) serve to confirm Hutchinson's observations[10] that the vital capacity was diminished even in early tuberculosis, and (2) they show that this decrease in incipient tuberculosis is not due to a diminished total lung volume, as previously supposed, but to an increased residual air. The increased residual air is the result of an inability to expire as deeply as normally. This inability to expire is apparent in the decreased movement of the diaphragm and the decreased difference between the chest volume after total expiration and in the middle position. Whether it is mechanically caused, by stiffness of the lungs, or is due to a reflex preventing compression, we cannot tell.

Patients with Moderately Advanced and Advanced Tuberculosis.

Group II includes thirteen moderately advanced cases (Text-fig. 33, Nos. 10 to 22) and Group III nine advanced cases (Text-fig. 34, Nos. 23 to 31). The two groups can be discussed together because the differences are not great. The picture here differs materially from that found in normal individuals and in the incipient cases. The vital capacity is diminished in all the patients, in most of them very considerably (see the value of the vital ratio in Text-figs. 1 to 31; the normal is 42). The reason for this decrease is, however, principally a decrease in the total capacity, which is only within normal limits in five patients in Group II (Nos. 11, 12, 14, 16, and 19) and two patients in Group III (Nos. 26 and 28). The residual air is, in most of the patients, fairly normal. An increase in the residual air is found only in Nos. 11, 12, 18, and 19 in Group II, and Nos. 26, 27, 28, and 30 in Group III. But, as a whole, it can be said that the vital capacity in the cases in these two groups is considerably diminished, due principally to a diminished total capacity. The cause of the diminished total capacity is not principally due to an impossibility to extend the thorax, as will be seen from the figures for the chest volumes. A comparison of the figures for the chest volumes in the three positions in the individual sub-

[10] Later investigators, as mentioned, have reported the same observations.

jects shows this. The essential reason is simply that the lungs do not have so much air space as in normal individuals. It is a direct expression of one phase of the pathologic anatomic process, the proliferation. Actual cavities may presumably increase the air

TABLE I.

The Influence of Change of Position and of Exercise on Pulse and Respiration.

No. on individual diagrams.	Case No.	Resting in bed.		Standing up.		After having run up three flights of stairs.		
		Pulse.	Respirations.	Pulse.	Respirations.	Pulse.	Respirations.	Other symptoms.
Group I.								
1	4315	72	11	106	20	110	20	None.
2	3606	66	14	70	16	98	14	Headache.
3	4362	74	16	86	20	100	18	Slight palpitation and dyspnea.
4	4280	70	14	80	18	102	28	" dyspnea; slight flush.
5	4197	96	16	106	18	120	18	" palpitation and dyspnea.
6	4184	72	15	88	18	102	20	" dyspnea.
7	4326	72	15	92	18	98	18	" "
9	4254	64	16	72	18	88	18	None.
Group II.								
10	4028	76	20	126	24	132	24	"
11	4148	102	22	98	22	108	28	Irregular pulse; slight dyspnea.
13	4229	78	24	100	22	106	20	Moderate dyspnea.
14	4090	68	14	112	14	120	14	Slight " slight palpitation
15	4039	74	14	96	16	114	16	None.
16	3918	76	16	104	20	104	16	Moderate dyspnea; palpitation.
17	4363	80	16	100	20	110	20	Slight palpitation and dyspnea.
18	3997	88	18	100	20	120	22	Moderate dyspnea.
19	4268	64	15	102	18	102	24	Slight "
20	4006	66	12	112	14	120	14	" " slight palpitation.
21	4076	72	18	100	18	88	20	Moderate "
22	4082	72	8*	100	10	112	10	Slight flush.
Group III.								
25	4300	100	14	116	16	120	16	Moderate dyspnea.
26	4127	72	14	100	14	116	14	Slight "
27	4317	98	20	110	24	120	28	Moderate " headache; flushes.
28	4346	70	14	98	16	104	14	None.
29	3952	76	12	136	14	126	16	Slight dyspnea; flush.
31	4130	112	20	120	17	120	30	Marked " tremors; flush.

* Verified three times.

capacity of the lungs, but none of our data bears evidence of this increase. Probably the effect of cavity formation is overcome by that of the proliferation. The difference in the residual air in incipient and advanced cases is peculiar; we shall not discuss it. Previous investigators found, as we also have found, a decrease in the vital capacity corresponding to an increase in the clinical symptoms (already shown by Hutchinson in nine patients in 1846).

We attempted to discover which of the clinical signs would correspond most closely to our findings, but have given this up. However, it seems that the stethoscopic findings, particularly the extent of the râles, have a closer relation than the x-ray shadows to the decrease in total and vital capacities. More light on this problem is highly desirable. We believe that the best way to add to present knowledge will be to follow single patients over considerable periods of time, comparing the clinical findings with the pulmometry. In Table I we have given the results of our determinations of the pulse rate and respiration before and after exercise. We think that no conclusions can be drawn from them at present. It is worth mentioning that exercise influences the rate of respiration only to a small extent, whereas the pulse rate seems to be abnormally increased. The determinations of the movements of the diaphragm show a smaller excursion than we found in normal subjects.[7] The significance of this, as far as the lung volumes are concerned, has already been mentioned. What relation it has to the pathologic process in the lungs is not yet clear.

SUMMARY.

1. The total capacity, middle capacity, and residual air have been determined in 31 adult male patients suffering from tuberculosis of the lungs.

2. The chest volumes have been determined in each case and the normal lung volumes calculated by means of the ratios worked out in a previous paper.

3. In nine patients with incipient tuberculosis, the total lung volume was found within normal limits, whereas the vital capacity was diminished as a result of an increased residual air.

The increase in the residual air was due to less complete expira-

tion, caused partly by diminished movement of the diaphragm, partly by diminished compression of the chest wall. The diminished movement of the diaphragm was, as a rule, most marked on the most affected side. Whether these decreased movements are due to a reflex or to stiffness of the lung tissue we could not determine.

The middle capacity was found practically normal.

4. In twenty-two cases of moderately advanced and advanced tuberculosis, the total lung volume was in most cases markedly decreased.

The vital capacity was substantially decreased, principally as a result of the diminished total capacity. The residual air was, as a rule, normal, although in a few cases an increase in residual air also contributed to the decrease in the vital capacity.

The middle capacity, on which we do not want to put too much stress, was normal in some patients and considerably diminished in others.

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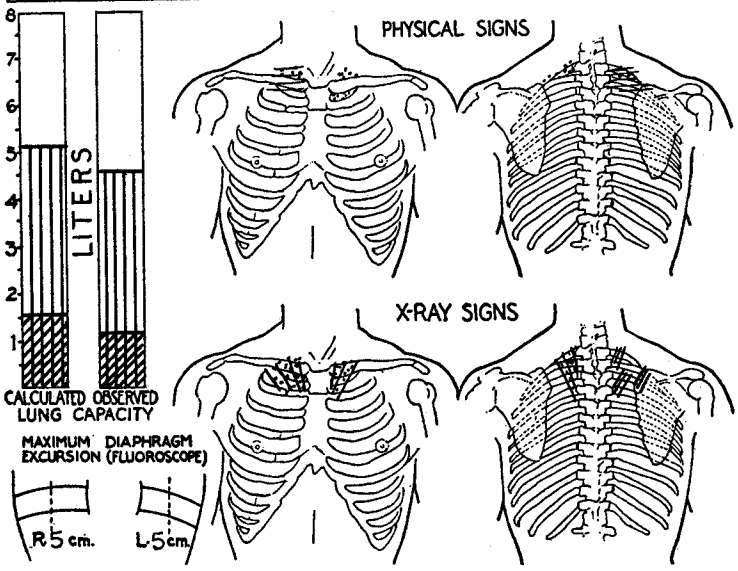
[11] For the other papers quoted see the bibliography in Paper I.

No. 1 (CASE 4315)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.8	16.1	24.9	8.30	—	—	41.0
MAX. INSP.	20.8	17.0	26.4	9.35	4.60	49.2	——
MAX. EXP.	20.8	15.8	24.7	8.13	1.20	14.8	——



TEXT-FIG. 1.

No. 1 (Case 4315).—Male, elevator operator; age 26 years. Incipient; inactive. Sputum— — —, on admission, in course of treatment, and at present.

Illness began about 7 years ago with expectoration, night sweats, and pain in left chest. Moderate loss in weight; moderate dyspnea. 3 months ago slight cough, moderate expectoration, slight dyspnea, and pain at left base. His general and his lung conditions have improved satisfactorily under sanatorium treatment.

	kg.
Height 165 cm. Theoretical normal weight	62.0
Present weight	59.0
Patient's idea of normal weight	56.5
Date of highest weight 0 months ago	59.0
" " lowest " 7 " "	48.5

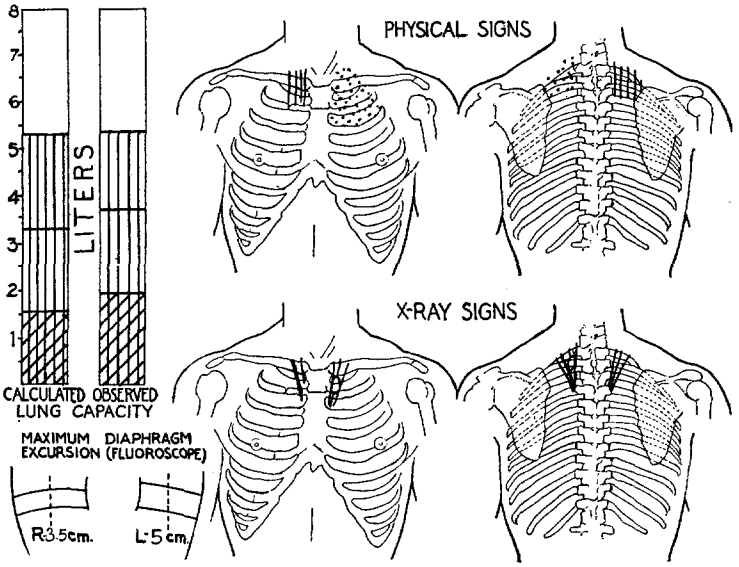
Treatment duration 3 months.

Physical Signs.—April 9, 1917. Moderate dullness at right apex. No great change in breath sounds. Few coarse râles on cough above right clavicle, posteriorly a few clicks above spine of scapula. Fine râles on cough at left apex above clavicle and in the first interspace. Posteriorly a few fine râles on cough above the spine of the scapula.

X-Ray Signs.—April 7, 1917. Right apex and first interspace moderately infiltrated. Slight infiltration of apex and first interspace on left side. Mediastinal contents centrally placed.

No. 2 (CASE 3606)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.5	18.0	23.8	8.78	3.67	41.7	39.8
MAX. INSP.	20.5	18.8	25.2	9.71	5.42	55.8	——
MAX. EXP.	20.5	17.1	23.3	8.17	1.92	23.4	——



TEXT-FIG. 2.

No. 2 (Case 3606).—Male, butcher; age 27 years. Incipient; inactive. Sputum — ± —, on admission, in course of treatment, and at present.

Onset 30 months ago with cough. Gastric disturbances; loss of 3 kg. in weight; marked loss in strength. Slight hemoptysis 2 years ago. Under sanatorium treatment his cough has entirely disappeared; expectoration has lessened; general physical condition improved; lung signs improved.

	kg.
Height 174 cm. Theoretical normal weight	68.0
Present weight	60.0
Patient's idea of normal weight	60.0
Date of highest weight 12 months ago	65.5
" " lowest " 28 " "	55.5

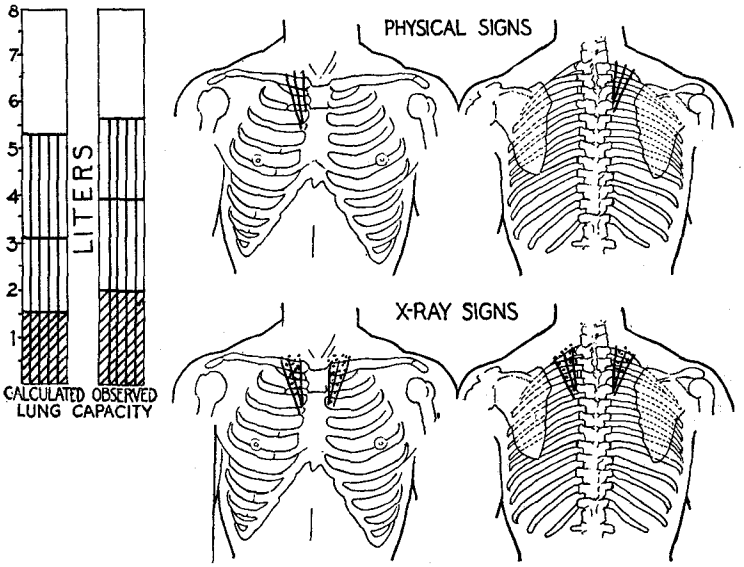
Treatment duration 22 months.

Physical Signs.—April 9, 1917. Slight dullness on percussion at right apex. Breath sounds at right apex slightly harsh. No râles. No change in percussion of left lung. Breath sounds slightly weak at apex. Fine râles on cough at apex to second rib anteriorly and to the third dorsal spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex slightly stippled and infiltrated. Left apex densely infiltrated. Chest below inner end of clavicle has a circular cavity 1½ cm. in diameter. Mediastinal contents normal.

No. 3 (CASE 4362)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	19.5	17.6	24.6	8.47	4.03	47.7	45.8
MAX. INSP.	19.5	19.1	26.1	9.73	5.68	58.4	——
MAX. EXP.	19.5	17.0	24.0	7.95	2.08	26.1	——



TEXT-FIG. 3.

No. 3 (Case 4362).—Male, chauffeur; age 29 years. Incipient; inactive. Sputum + on admission.

Onset 9 months ago. Malaise and tendency to tire easily; later a few night sweats; loss of 2 kg. in weight. Doing well under sanatorium treatment, with no marked symptoms.

	kg.
Height 173 cm. Theoretical normal weight	68.5
Present weight	62.5
Patient's idea of normal weight	63.0
Date of highest weight 13 months ago	63.0
" " lowest " 4 " "	59.5

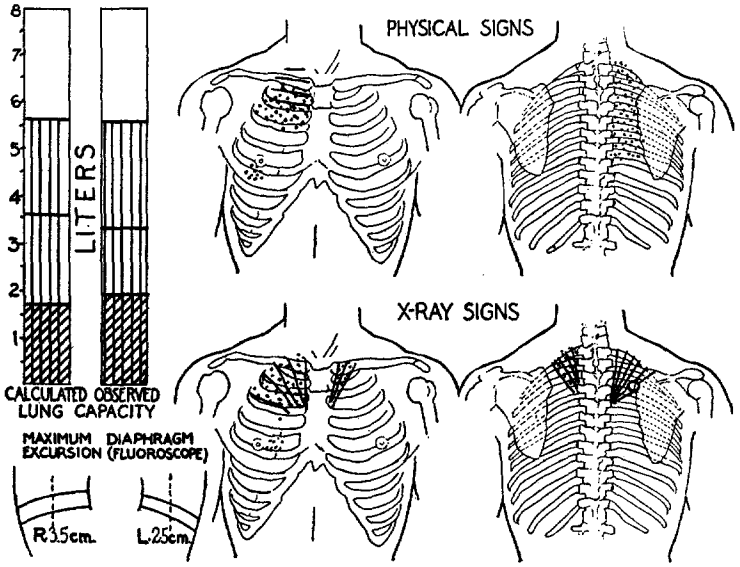
Treatment duration 1 month.

Physical Signs.—April 9, 1917. Slight dullness at right apex. No great change in breath sounds. No râles heard.

X-Ray Signs.—April 7, 1917. Right apex slight haze. Rest of lung normal. Left apex very slight haze. Rest of lung normal. Posteriorly infiltration of both apices more dense than anteriorly. Mediastinal contents normal.

No. 4 (CASE 4280)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	19.7	18.8	26.4	9.76	3.30	33.7	37.0
MAX. INSP.	19.7	19.3	27.1	10.28	5.58	54.3	——
MAX. EXP.	19.7	18.4	25.8	9.35	2.00	21.4	——



TEXT-FIG. 4.

No. 4 (Case 4280).—Male, furrier; age 27 years. Incipient; inactive. Sputum — — —, on admission, in course of treatment, and at present.

Illness began 13 months ago with pleurisy at right base, chills, and night sweats. Cessation of symptoms after 3 weeks until 6 months ago, then return of night sweats, with considerable pain in chest. Under sanatorium treatment his general condition has remained continuously good and he has had practically no symptoms.

	kg.
Height 171 cm. Theoretical normal weight	68.0
Present weight	65.0
Patient's idea of normal weight	67.0
Date of highest weight 1913	68.0
" " lowest " 7 months ago	59.5

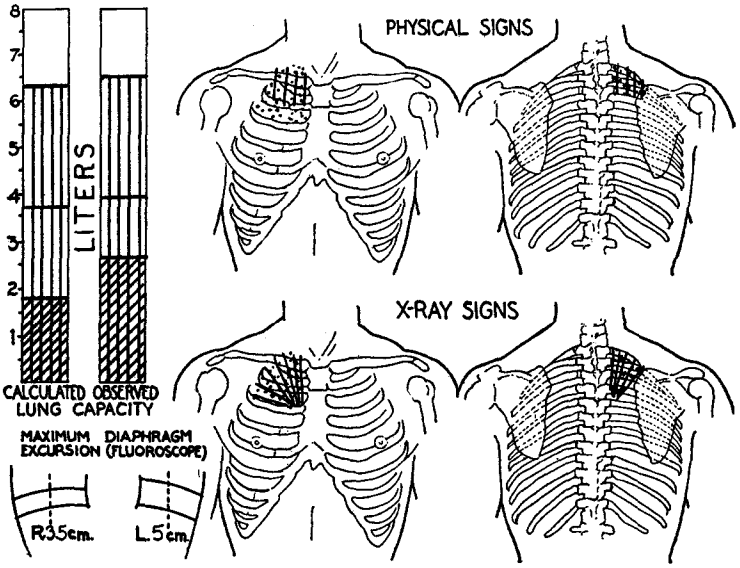
Treatment duration 4 months.

Physical Signs.—April 9, 1917. Moderate dullness at right apex to second rib. No marked change in breath sounds. Medium moist râles on cough at right apex from clavicle to third rib anteriorly, and from the apex to an inch above the angle of the scapula posteriorly. A few medium râles on cough below the right nipple.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces moderately densely infiltrated. In the fourth interspace a small spot of stippling 3 cm. in diameter. A cavity posteriorly in the third interspace 2½ cm. in diameter. Left apex slightly stippled. Mediastinal contents normal.

No. 5 (CASE 4197)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	21.3	18.8	25.2	10.1	3.95	39.1	38.0
MAX. INSP.	21.3	19.9	27.2	11.5	6.55	57.0	——
MAX. EXP.	21.3	18.0	25.0	9.6	2.70	28.1	——



TEXT-FIG. 5.

No. 5 (Case 4197).—Male, glove cutter; age 19 years. Incipient; inactive. Sputum — + +, on admission, in course of treatment, and at present.

Present illness began 8 months ago with moderate hemoptysis. Later moderate cough with profuse expectoration. Occasional night sweats. He has been in good general condition during his stay in the sanatorium; still has a slight cough and slight expectoration. His lung condition seems unchanged.

	kg.
Height 175 cm. Theoretical normal weight	67.5
Present weight	71.5
Patient's idea of normal weight	68.0
Date of highest weight 4 months ago	72.5
" " lowest " 19 " "	66.0

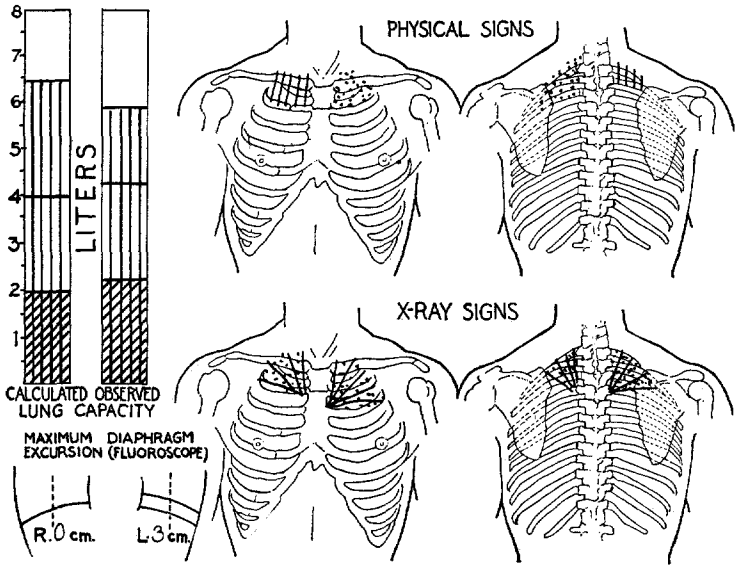
Treatment duration 6 months.

Physical Signs.—April 9, 1917. Slight dullness at right apex to second rib anteriorly and third spine posteriorly. Breath sounds slightly harsh in the same area. Fine râles on cough from the apex to the third rib anteriorly and to the third spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces moderately densely infiltrated. Mediastinal contents normal.

No. 6 (CASE 4184)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	22.4	16.9	28.1	10.7	4.30	40.0	34.1
MAX. INSP.	22.4	17.9	29.1	11.7	5.85	50.0	——
MAX. EXP.	22.4	16.7	27.8	10.4	2.20	21.1	——



TEXT-FIG. 6.

No. 6 (Case 4184).—Male, machinist; age 20 years. Incipient; inactive. Sputum + + +, on admission, in course of treatment, and at present.

Present illness began 10 months ago with malaise, slight morning cough, and expectoration; frequent night sweats. Pain in upper part of right lung. Streaked sputum occasionally for the first 3 months. His general condition has been good under sanatorium treatment; still has slight cough with moderate expectoration, occasionally blood-streaked. His lung signs have slightly increased.

	kg.
Height 178 cm. Theoretical normal weight	69.5
Present weight	75.0
Patient's idea of normal weight	71.5
Date of highest weight 4 months ago	76.0
" " lowest " 7 " "	69.0

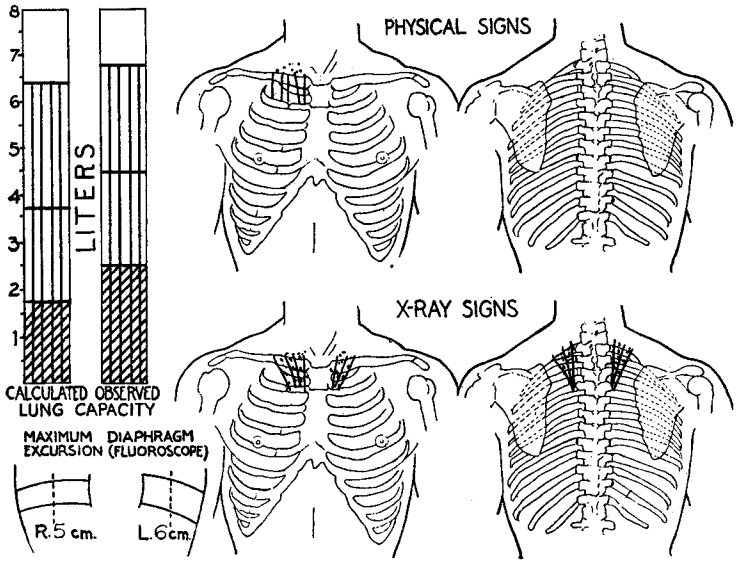
Treatment duration 6 months.

Physical Signs.—April 9, 1917. Slight dullness at right apex to second rib anteriorly and to the second spine posteriorly. Breath sounds slightly harsh in this area. Medium moist râles on cough at left apex to the second rib anteriorly and to the third dorsal spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first interspace slightly infiltrated. Left apex and first and second interspaces slightly stippled and infiltrated. Mediastinal contents normal.

No. 7 (CASE 4326)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.7	19.0	26.1	10.25	4.51	44.0	41.9
MAX. INSP.	20.7	20.8	27.3	11.75	6.83	58.1	——
MAX. EXP.	20.7	18.4	25.5	9.71	2.53	24.5	——



TEXT-FIG. 7.

No. 7 (Case 4326).—Male, butcher; age 38 years. Incipient; inactive. Sputum — — —, on admission, in course of treatment, and at present.

Onset 26 months ago with malaise and tendency to tire readily. 6 months ago fever, chills, slight dyspnea, slight cough, and expectoration. His general condition has been greatly improved since admission to the hospital and his lung condition markedly bettered.

	kg.
Height 173 cm. Theoretical normal weight	71.5
Present weight	68.0
Patient's idea of normal weight	59.0
Date of highest weight 1 month ago	68.5
" " lowest " 4 months "	59.0

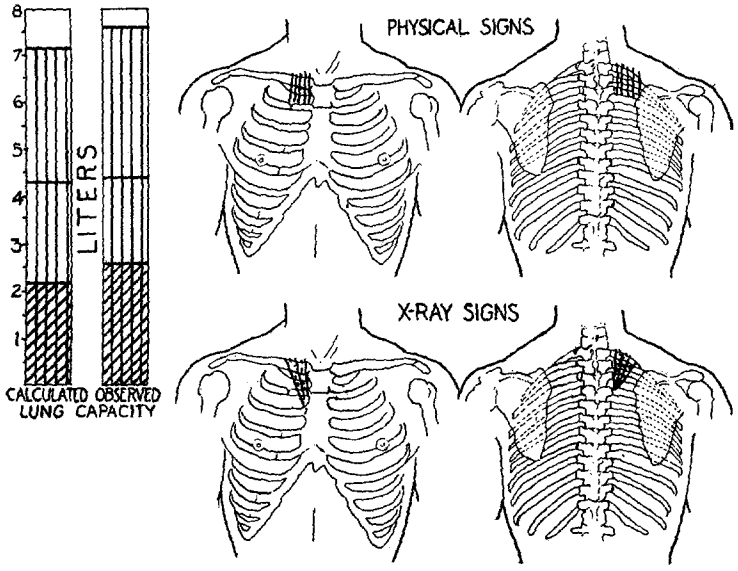
Treatment duration 2 months.

Physical Signs.—April 9, 1917. Slight dullness at right apex, especially at inner end of first interspace. Breath sounds slightly increased at left apex, both anteriorly and posteriorly. Very few fine râles on cough at right apex above the clavicle.

X-Ray Signs.—April 7, 1917. Right apex moderately densely spotted and striated. Left apex moderately densely spotted and striated. Mediastinal contents normal.

No. 8 (CASE 3651)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME."			
	cm.	cm.	cm.	liters	liters		
REST	23.0	19.0	26.5	11.60	4.37	37.7	44.0
MAX. INSP.	23.0	20.0	28.5	13.10	7.67	58.2	——
MAX. EXP.	23.0	18.0	26.0	10.60	2.57	24.2	——



TEXT-FIG. 8.

No. 8 (Case 3651).—Male, machinist; age 31 years. Incipient; inactive. Sputum + ± −, on admission, in course of treatment, and at present.

Onset 6 years, 8 months ago with cough and night sweats. Loss of 4.5 kg. in weight. Frequent small hemoptyses. Expectoration slight. Under sanatorium treatment he has remained in very good general condition with good improvement in lung condition.

	kg.
Height 183 cm. Theoretical normal weight	77.0
Present weight	75.0
Patient's idea of normal weight	74.0
Date of highest weight 8 years ago	79.5
" " lowest " 7 months"	74.0

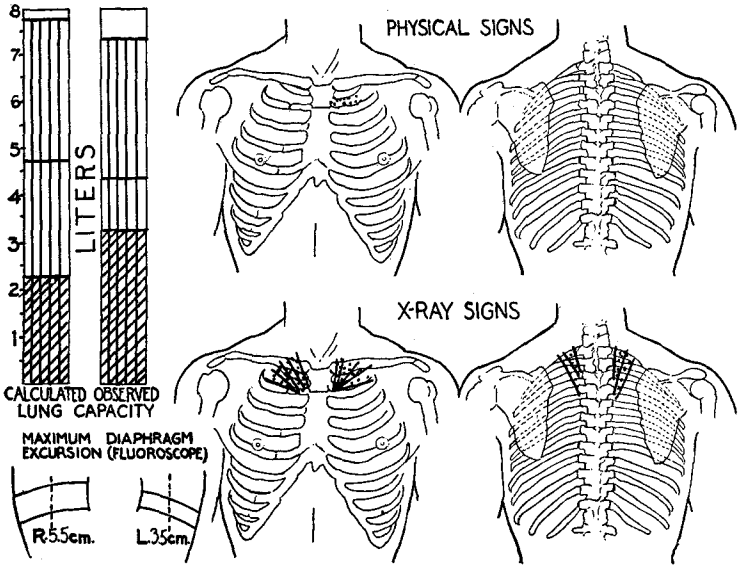
Treatment duration 22 months.

Physical Signs.—April 9, 1917. Percussion resonance of right apex slightly impaired. Breath sounds slightly increased at right apex. No râles heard, before or after cough. The patient had a small hemorrhage of 5 cc. 24 hours after the measurements were taken, caused by slipping on ice.

X-Ray Signs.—Right apex quite densely spotted and striated. Mediastinal contents normal.

No. 9 (CASE 4254)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.0	21.1	29.8	12.60	4.27	33.9	32.5
MAX. INSP.	20.0	22.8	31.7	14.50	7.39	50.9	——
MAX. EXP.	20.0	20.3	29.4	11.90	3.27	27.5	——



TEXT-FIG. 9.

No. 9 (Case 4254).—Male, carpenter; age 38 years. Incipient; active. Sputum — ± —, on admission, in course of treatment, and at present.

Onset 8 months ago with cough. Expectoration slight at first, later moderate. Headaches; slight dyspnea. Loss of 3 kg. in weight. His lung condition has improved under sanatorium treatment and his general physical condition has been excellent.

	kg.
Height 170 cm. Theoretical normal weight	69.5
Present weight	87.5
Patient's idea of normal weight	80.5
Date of highest weight 0 months ago	87.5
" " lowest " 8 " "	76.5

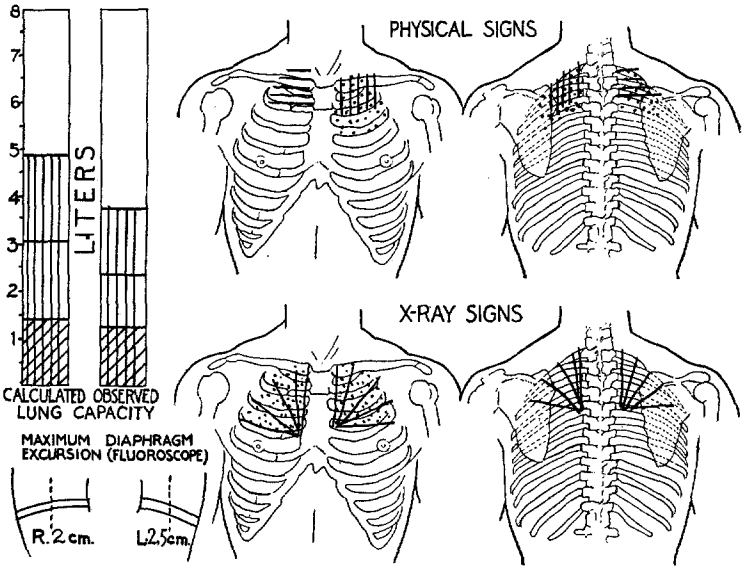
Treatment duration 5 months.

Physical Signs.—April 9, 1917. No great percussion changes. No marked changes in respiratory sounds. Few fine râles on cough at the inner end of the first interspace on the left side.

X-Ray Signs.—April 7, 1917. Right apex and first interspace densely infiltrated. Left apex and first interspace slightly infiltrated. Mediastinal contents normal.

No. 10 (CASE 4028)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	19.0	16.9	25.5	8.18	2.35	28.8	29.4
MAX. INSP.	19.0	17.8	26.6	9.0	3.70	41.3	——
MAX. EXP.	19.0	15.7	25.3	7.56	1.30	17.2	——



TEXT-FIG. 10.

No. 10 (Case 4028).—Male, student; age 17 years. Moderately advanced; active. Sputum − + +, on admission, in course of treatment, and at present.

Onset 13 months ago with a cold. Cough severe; expectoration slight. Moderate dyspnea. Occasional chills. 2 weeks after onset a profuse hemoptysis. Loss of 2.7 kg. in weight. His symptoms remain about the same under sanatorium treatment. Physical signs have increased. General condition remains fair.

	kg.
Height 168 cm. Theoretical normal weight	57.5
Present weight	61.0
Patient's idea of normal weight	59.0
Date of highest weight 0 months ago	61.0
" " lowest " 7 " "	48.0

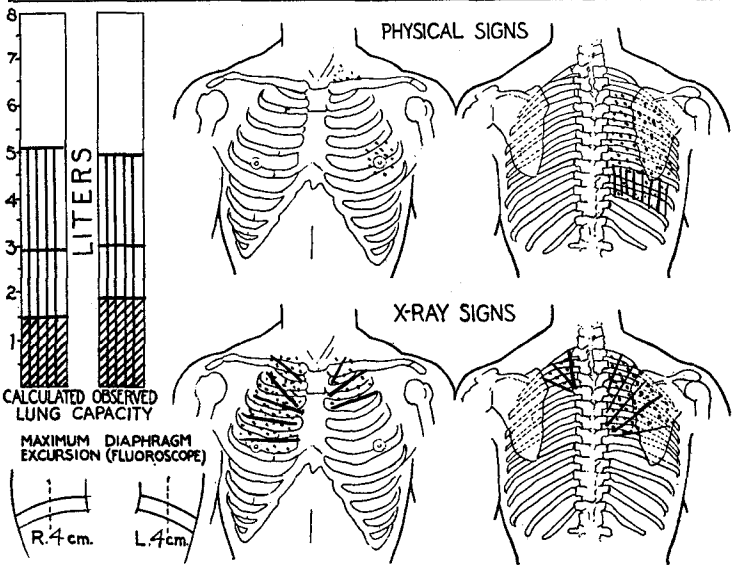
Treatment duration 11 months.

Physical Signs.—April 9, 1917. Moderate dullness at right apex to second rib anteriorly and third spine posteriorly. Slight dullness at left apex to second rib anteriorly and third spine posteriorly. Breath sounds moderately harsh at right upper thorax. Breath sounds feeble at left upper thorax. Râles on cough, fine and medium, at right apex to fourth spine posteriorly. Medium râles on cough at left apex to third rib anteriorly and fourth spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first, second, and third interspaces moderately stippled. Left apex and first, second, and third interspaces moderately stippled. Mediastinal contents normal.

No. 11 (CASE 4148)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	19.2	17.2	24.1	7.92	3.05	38.5	37.7
MAX. INSP.	19.2	18.6	25.9	9.25	4.90	53.0	——
MAX. EXP.	19.2	16.8	23.9	7.72	1.90	24.6	——



TEXT-FIG. 11.

No. 11 (Case 4148).—Male, freight house clerk; age 23 years. Moderately advanced; inactive. Sputum + ± −, on admission, in course of treatment, and at present.

Onset 18 months ago with hemoptysis. Cough moderate; expectoration slight. Few night sweats. Loss of 4.5 kg. in weight. During his sanatorium stay he has remained in good general condition. Lung condition slightly improved.

	kg.
Height 175 cm. Theoretical normal weight	69.0
Present weight	59.5
Patient's idea of normal weight	56.0
Date of highest weight 1 month ago	60.5
" " lowest " 7 months "	50.5

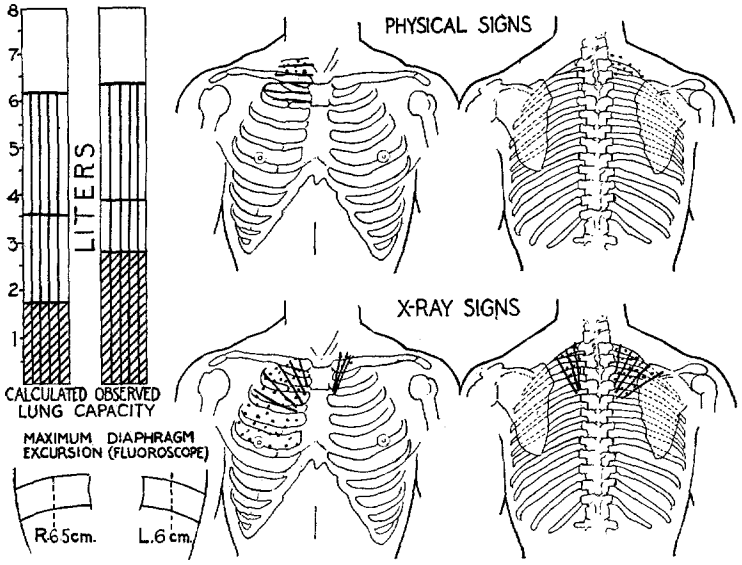
Treatment duration 7 months.

Physical Signs.—April 9, 1917. Slight dullness at right base posteriorly. No great change in breath sounds. Fine moist râles on cough at left apex above the clavicle. Fine moist râles on cough at the left anterior third and fourth interspaces in the region of the nipple. Fine moist râles on cough posteriorly on the right side from the spine of the scapula above to the base.

X-Ray Signs.—April 7, 1917. Right, fine stipplings from the apex to the fourth interspace. Left, moderate stippling from the apex to the second interspace. Mediastinal contents slightly to the right.

No. 12 (CASE 3990)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.0	20.0	24.0	9.60	3.89	40.5	37.5
MAX. INSP.	20.0	22.0	25.5	11.20	6.34	56.7	——
MAX. EXP.	20.0	19.5	23.5	9.20	2.74	29.8	——



TEXT-FIG. 12.

No. 12 (Case 3990).—Male, machinist; age 25 years. Moderately advanced; inactive. Sputum — — —, on admission, in course of treatment, and at present.

Onset 30 months ago with hemoptysis. Loss of 4 kg. in weight. Pain in chest slight. Slight dyspnea. Slight expectoration. During his hospital stay he has remained in fair general condition with moderate improvement in lung condition.

	kg.
Height 170 cm. Theoretical normal weight	65.5
Present weight	65.5
Patient's idea of normal weight	60.5
Date of highest weight 10 months ago	68.0
" " lowest " 2 years "	58.5

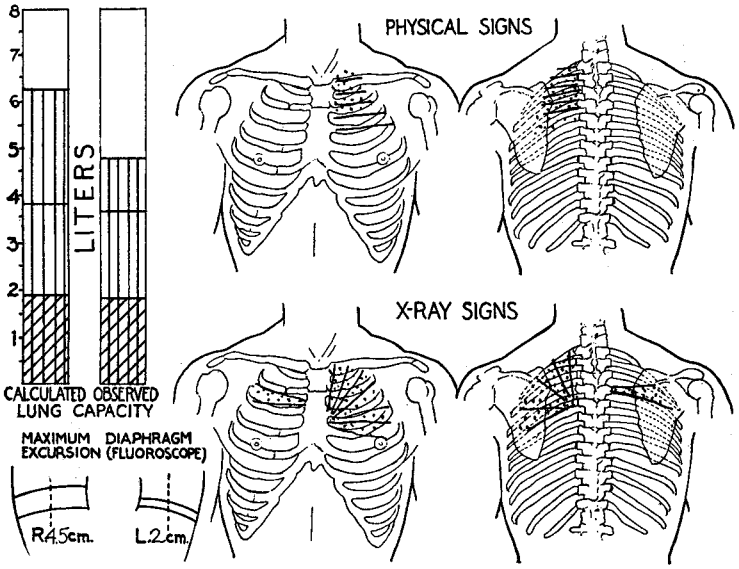
Treatment duration 12 months.

Physical Signs.—April 9, 1917. Dullness at upper part of right lung anteriorly to the second rib. Increased breath sounds at upper part of right lung anteriorly to the second rib and posteriorly to the spine of the scapula. Medium moist rales on cough at the right apex, above the clavicle anteriorly, and to the spine of the scapula posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces quite densely spotted and striated. The third and fourth interspaces show very fine spottings. Left apex slightly spotted; rest of lung normal. Mediastinal contents normal.

No. 13 (CASE 4229)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 × LUNG CAP. / CHEST VOL.	RATIO 100 × VITAL CAP. / CHEST VOL.
	STERNUM	ANTEPOST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	21.0	18.8	26.1	10.30	3.75	36.4	28.1
MAX. INSP.	21.0	19.7	27.4	11.35	4.70	41.4	—
MAX. EXP.	21.0	18.4	25.8	10.00	1.80	18.0	—



TEXT-FIG. 13.

No. 13 (Case 4229).—Male, music teacher; age 42 years. Moderately advanced; active. Sputum + + +, on admission, in course of treatment, and at present.

Onset 12 months ago with heavy cold. Cough moderate; expectoration profuse after 2 weeks. Dyspnea moderate. Loss of 2.7 kg. in weight. 2 months after onset profuse hemoptysis. Pain in left side. Under treatment in the hospital he has improved in general condition; cough and expectoration moderate. The physical signs remain about the same.

	kg.
Height 170 cm. Theoretical normal weight	70.0
Present weight	65.0
Patient's idea of normal weight	61.0
Date of highest weight 2 months ago	65.5
" " lowest " 5 " "	58.5

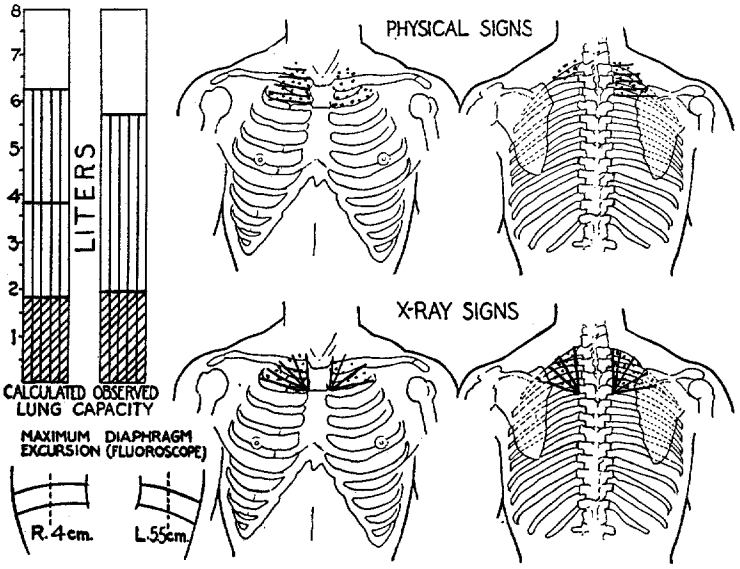
Treatment duration 5 months.

Physical Signs.—April 9, 1917. Moderate dullness on percussion over the left apex and from the apex to the third rib anteriorly and to the fourth spine posteriorly. Breath sounds moderately harsh in this area. Râles on coughing, fine and medium, from apex to the second rib anteriorly and to the fifth spine posteriorly.

X-Ray Signs.—April 7, 1917. Right lung, second interspace slightly stippled. Left upper lobe moderately densely spotted and stippled. Mediastinal contents slightly to the left above.

No. 14 (CASE 4090)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.5	18.7	27.0	10.4	—	—	32.7
MAX. INSP.	20.5	20.0	27.9	11.4	5.7	50.0	——
MAX. EXP.	20.5	17.8	26.2	9.6	2.0	20.9	——



TEXT-FIG. 14.

No. 14 (Case 4090).—Male, lithographer; age 32 years. Moderately advanced; inactive. Sputum + ± +, on admission, in course of treatment, and at present.

Present illness began 13 months ago with neurasthenic symptoms, insomnia, etc. 2 months later slight cough with scanty expectoration; no other symptoms. Under sanatorium treatment his cough has lessened. Has complained of insomnia. General physical condition has bettered. His lung signs have improved slightly.

	kg.
Height 177 cm. Theoretical normal weight	74.5
Present weight	76.0
Patient's idea of normal weight	72.5
Date of highest weight 8 years ago	85.0
" " lowest " 7 months "	69.5

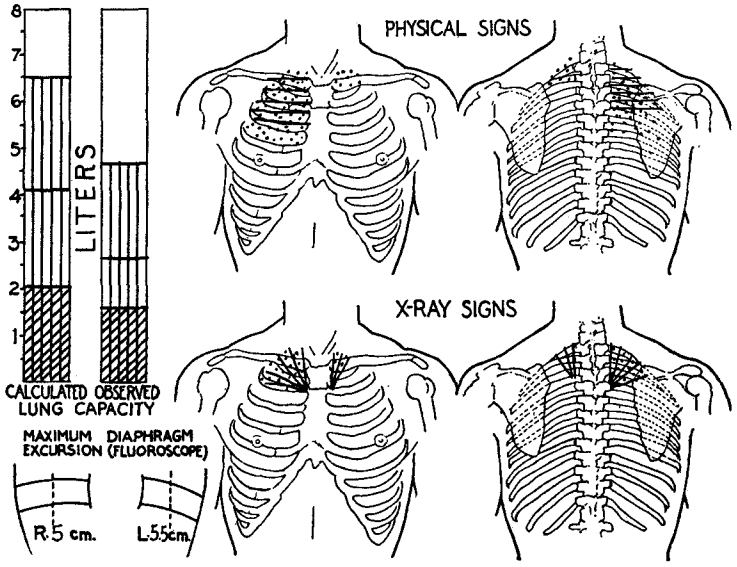
Treatment duration 9 months.

Physical Signs.—April 9, 1917. Moderate dullness at right apex to second rib anteriorly and to third spine posteriorly. Moderately harsh breathing in this area. Breath sounds slightly feeble at left apex. Fine râles at right apex to second rib anteriorly and to third spine posteriorly. Fine râles on cough at left apex to second rib anteriorly and to second spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first interspace moderately densely infiltrated. Left apex and first interspace similarly infiltrated. Mediastinal contents normal

No. 15 (CASE 4039)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	21.5	19.6	26.5	11.2	2.65	23.7	26.9
MAX. INSP.	21.5	20.0	27.4	11.8	4.6	39.0	——
MAX. EXP.	21.5	18.9	26.1	10.6	1.6	15.0	——



TEXT-FIG. 15.

No. 15 (Case 4039).—Male, clothing cutter; age 28 years. Moderately advanced; inactive. Sputum + + +, on admission, in course of treatment, and at present.

Onset 6 years ago with cold. Persistent cough. Hemoptysis slight 6 months after onset. 2 years ago series of severe hemoptyses. Artificial pneumothorax. Has felt well and is near his normal weight since recovery after hemoptyses. Under sanatorium treatment his symptoms have remained slight; very little cough, slight expectoration. His physical condition has been excellent.

	kg.
Height 175 cm. Theoretical normal weight	70.5
Present weight	72.0
Patient's idea of normal weight	72.5
Date of highest weight 4 years ago	77.0
" " lowest " 28 months "	54.5

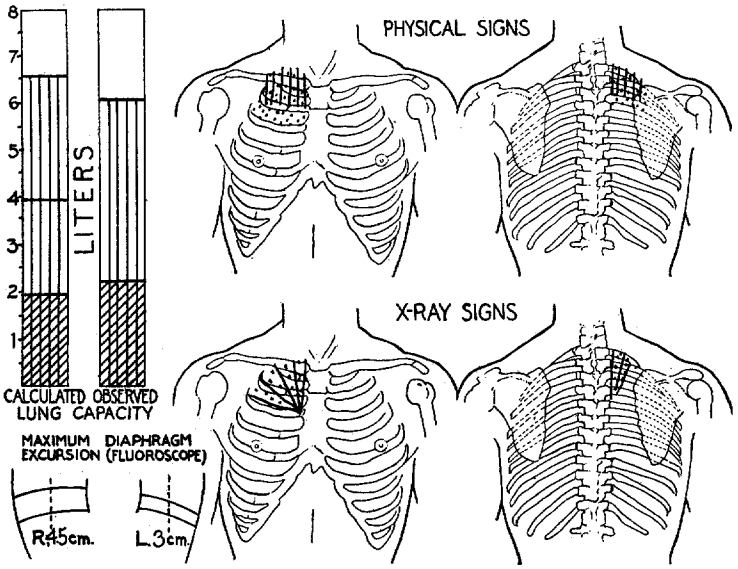
Treatment duration 10 months.

Physical Signs.—April 9, 1917. Moderate dullness on percussion at right apex to the third rib anteriorly and to the fourth spine posteriorly. Breath sounds moderately harsh. Râles on cough, fine and medium, at apex to the fourth rib anteriorly and to the sixth spine posteriorly. Breath sounds slightly feeble at left apex. Medium moist râles on cough at apex to second rib anteriorly and to the second spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first interspace densely infiltrated. Left apex slightly infiltrated. Mediastinal contents normal.

No. 16 (CASE 3918)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.4	18.1	29.4	10.75	—	—	34.8
MAX. INSP.	20.4	19.1	30.8	11.93	6.10	51.3	——
MAX. EXP.	20.4	17.6	28.9	10.38	2.25	21.6	——



TEXT-FIG. 16.

No. 16 (Case 3918).—Male, factory inspector; age 27 years. Moderately advanced; inactive. Sputum + + −, on admission, in course of treatment, and at present.

Onset 19 months ago with malaise, loss in strength; 2 months later fever and cough. Sputum occasionally blood-streaked. Loss of 3 kg. in weight. Occasional night sweats. Dyspnea slight. Under sanatorium treatment he has remained in fair general condition. Complications of larynx and rectal fistula have arisen. Slight hemoptysis frequent. Symptoms and lung condition remain the same.

	kg.
Height 175 cm. Theoretical normal weight	70.0
Present weight	71.0
Patient's idea of normal weight	70.0
Date of highest weight 0 months ago	71.0
" " lowest " 8 " "	63.5

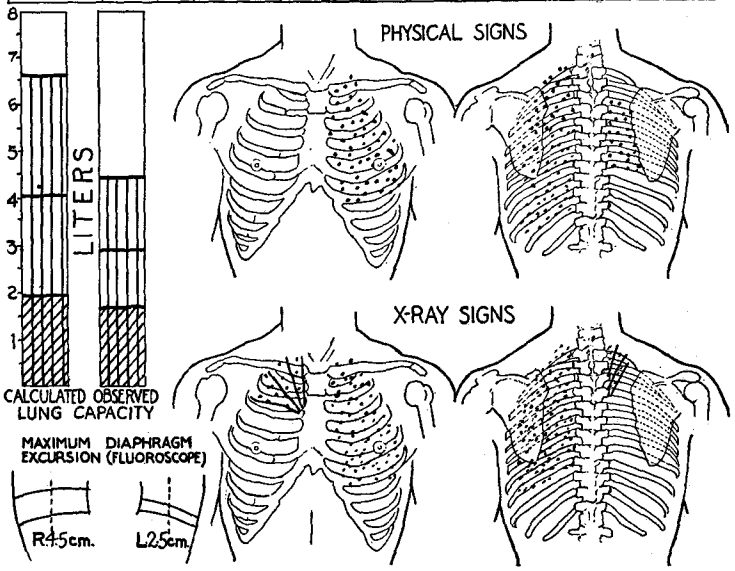
Treatment duration 13 months.

Physical Signs.—April 9, 1917. Slightly dull percussion note at right apex to second rib anteriorly and to third spine posteriorly. Breath sounds moderately harsh in the same area. Fine and medium râles on cough at right apex to the third rib anteriorly and to the fourth spine posteriorly.

X-Ray Signs.—April 7, 1917. Right upper lobe moderately densely infiltrated to the third rib. Mediastinal contents normal.

No. 17 (CASE 4363)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.0	19.7	28.0	11.04	2.9	26.3	24.9
MAX. INSP.	20.0	20.7	29.1	12.06	4.45	36.9	——
MAX. EXP.	20.0	18.9	27.0	10.20	1.7	16.6	——



TEXT-FIG. 17.

No. 17 (Case 4363).—Male, sign writer; age 29 years. Moderately advanced; active. Sputum + on admission.

Present illness began 25 months ago with malaise and tendency to tire easily. Gastric symptoms. Loss of 4.5 kg. in weight. Later moderate cough with scanty expectoration. His physical condition remains good under sanatorium treatment; symptoms about the same. Lung condition about the same.

	kg.
Height 174 cm. Theoretical normal weight	70.0
Present weight	69.0
Patient's idea of normal weight	70.0
Date of highest weight 19 months ago	75.5
" " lowest " 17 " "	60.0

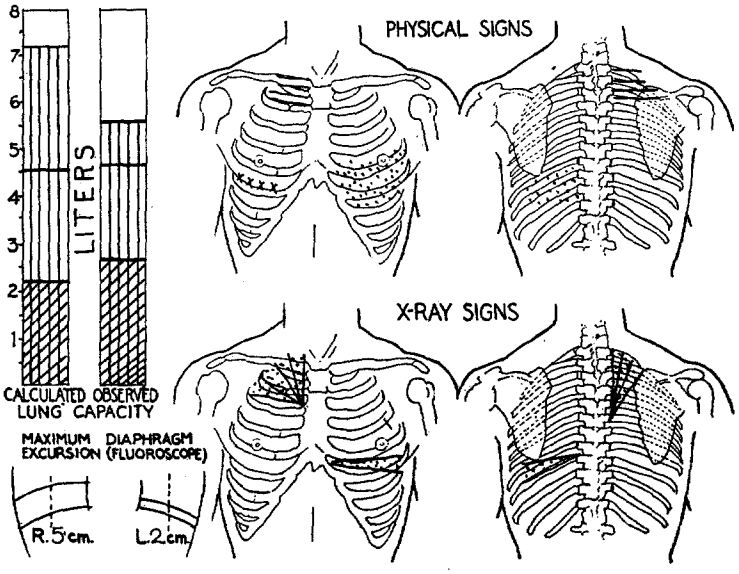
Treatment duration 1 month.

Physical Signs.—April 7, 1917. No marked percussion changes. Increased breath sounds at right apex posteriorly. Fine râles on cough posteriorly from spine to angle of scapula. Medium and coarse râles, on cough, in left lung anteriorly and posteriorly from apex to base.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces slightly infiltrated. Rest of lung normal. Entire left lung slightly infiltrated, with fine spotting. Mediastinal contents completely to the left. Right lung area large.

No. 18 (CASE 3997)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	22.0	19.1	28.9	12.2	4.62	37.7	24.2
MAX. INSP.	22.0	19.9	29.9	13.1	5.57	42.5	——
MAX. EXP.	22.0	18.3	28.6	11.5	2.62	22.8	——



TEXT-FIG. 18.

No. 18 (Case 3997).—Male, machinist; age 27 years. Moderately advanced; inactive. Sputum − ± +, on admission, in course of treatment, and at present.

Onset 16 months ago with moderate hemoptysis; later slight cough, occasional night sweat, and loss of 2 kg. in weight. Has felt well during his entire stay in the hospital.

	kg.
Height 174 cm. Theoretical normal weight	70.0
Present weight	76.5
Patient's idea of normal weight	66.0
Date of highest weight 6 months ago	79.0
" " lowest " ? " "	70.0

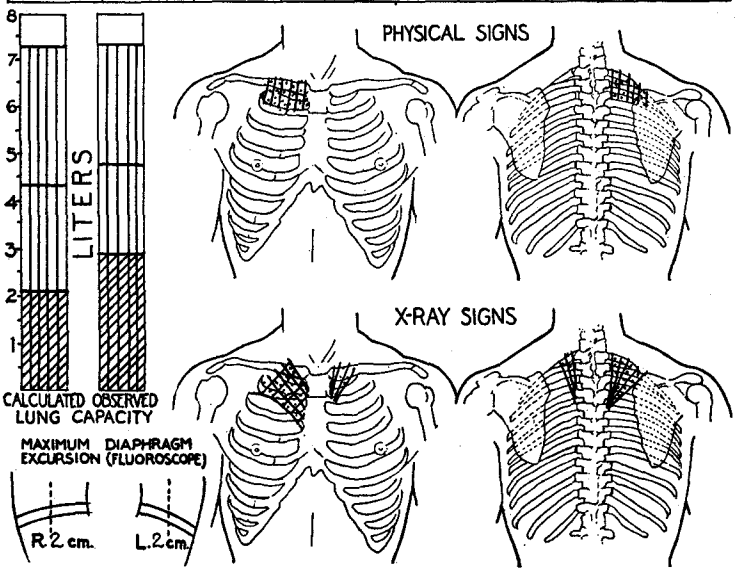
Treatment duration 12 months.

Physical Signs.—April 9, 1917. Moderate dullness at right apex, anteriorly to the second rib, posteriorly to the spine of the scapula. Breath sounds slightly increased at the left base. Fine moist râles on cough at left base, anteriorly below the fourth rib, posteriorly below a point midway between the spine and the angle of the scapula. Friction rubs at right base anteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces slightly stippled and striated. Left, fifth interspace moderately spotted and striated. Mediastinal contents normal.

No. 19 (CASE 4268)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.0	20.0	29.7	11.9	4.78	40.2	38.2
MAX. INSP.	20.0	21.5	31.2	13.4	7.38	55.0	——
MAX. EXP.	20.0	19.5	28.6	11.1	2.93	26.4	——



TEXT-FIG. 19.

No. 19 (Case 4268).—Male, teamster; age 29 years. Moderately advanced; inactive. Sputum + ± −, on admission, in course of treatment, and at present.

Present illness began 14 months ago after an attack of supposed influenza. Malaise; weakness; loss of 6.8 kg. in weight; 5 months after onset afternoon fever; occasional chills. Shortly after began to cough; expectoration profuse. Slight pain in left base. Under sanatorium treatment his symptoms have largely disappeared, his general condition is excellent, and the lung condition is apparently greatly improved.

	kg.
Height 186 cm. Theoretical normal weight	78.0
Present weight	87.0
Patient's idea of normal weight	84.0
Date of highest weight 3 months ago	92.0
" " lowest " 10 " "	79.5

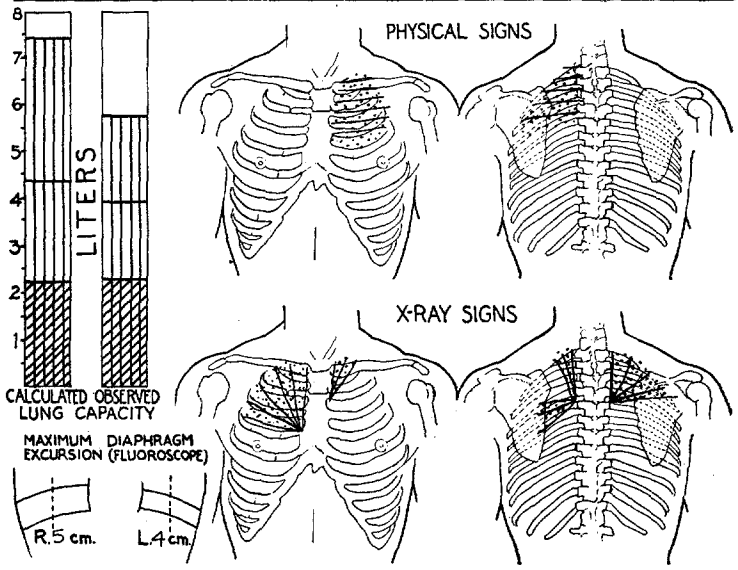
Treatment duration 5 months.

Physical Signs.—April 9, 1917. Slight dullness on percussion at right apex to the second rib anteriorly and the third dorsal spine posteriorly. Breath sounds slightly harsh. Fine râles on cough at apex to second rib anteriorly and to third spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces densely infiltrated. The lower edge of the infiltration is sharply limited from healthy lung below. Left apex infiltrated. Mediastinal contents normal.

No. 20 (CASE 4006)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	21.2	19.8	28.5	11.95	3.90	32.5	29.3
MAX.INSP.	21.2	21.1	30.2	13.55	5.80	42.7	——
MAX.EXP.	21.2	19.6	28.2	11.70	2.30	19.7	——



TEXT-FIG. 20.

No. 20 (Case 4006).—Male, conductor on elevated railroad; age 33 years. Moderately advanced; inactive. Sputum – – –, on admission, in course of treatment, and at present.

Present illness began 27 months ago with bronchitis. Severe cough for 2 months. Fever; night sweats; loss of 5.4 kg. in weight. Moderate weakness. Hemoptysis of moderate amount 6 months after onset. Pain at left base. Under sanatorium treatment his symptoms remain about the same except improvement in strength. No fever since onset. His general physical condition remains excellent.

	kg.
Height 166 cm. Theoretical normal weight	64.5
Present weight	77.0
Patient's idea of normal weight	84.0
Date of highest weight 4 years ago	84.0
" " lowest " 8 months "	75.0

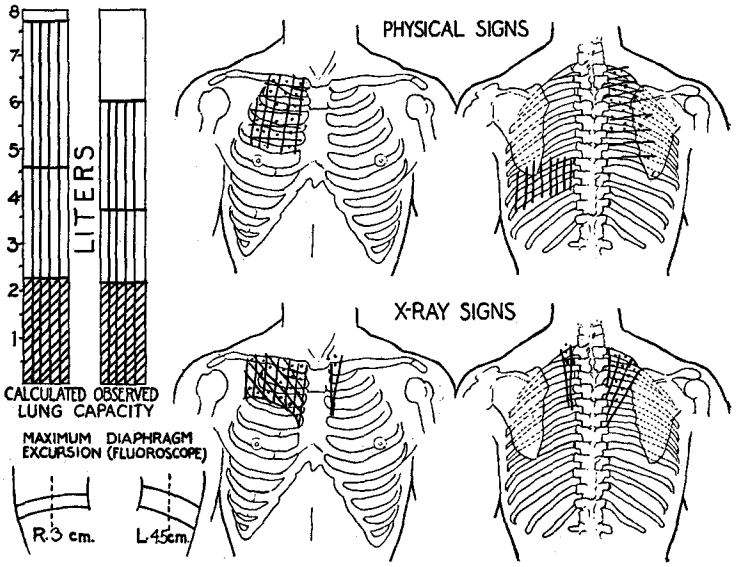
Treatment duration 11 months.

Physical Signs.—April 9, 1917. No change in percussion over right lung. Breath sounds slightly harsh at right apex. Moderate dullness at left apex to third rib anteriorly and to fourth spine posteriorly. Breath sounds feeble in the same area. Fine and medium râles on cough at left apex to fourth rib anteriorly and to fifth spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first three interspaces moderately densely striated and spotted. Left apex slight spotting. Mediastinal contents normal.

No. 21 (CASE 4076)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	21.5	19.5	29.7	12.4	3.70	29.8	31.4
MAX. INSP.	21.5	20.7	31.5	14.1	6.10	43.2	——
MAX. EXP.	21.5	19.0	29.4	12.0	2.20	18.8	——



TEXT-FIG. 21.

No. 21 (Case 4076).—Male, farmhand; age 27 years. Moderately advanced; inactive. Sputum — — —, on admission, in course of treatment, and at present.

Onset 34 months ago with fever; loss of 24.5 kg. in weight in the first 6 months. Chills; night sweats; cough and expectoration slight. Slight hemoptysis. General condition during his hospital stay has been excellent; lung condition improved.

	kg.
Height 183 cm. Theoretical normal weight	77.0
Present weight	89.0
Patient's idea of normal weight	86.0
Date of highest weight 12 months ago	97.0
" " lowest " 34 " "	61.5

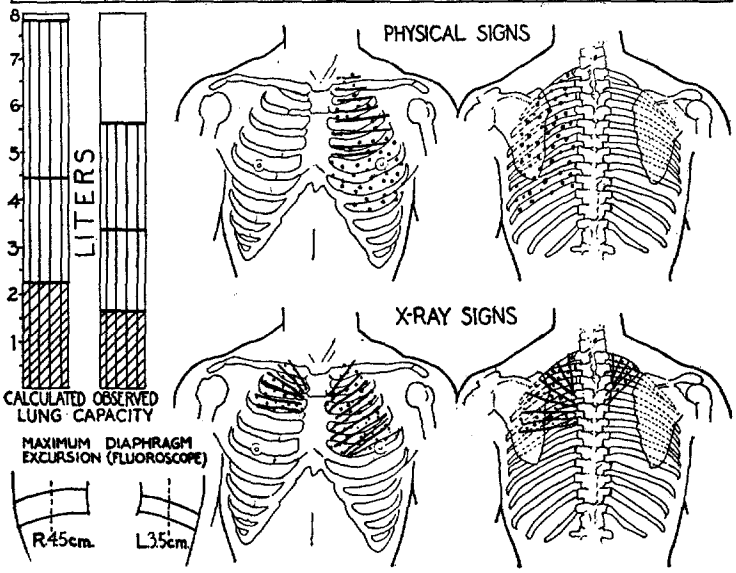
Treatment duration 10 months.

Physical Signs.—April 9, 1917. Marked dullness of right lung anteriorly to the fourth rib, posteriorly moderate dullness from apex to spine of the scapula. Slight dullness at the left base below angle of scapula. No great change in breath sounds. Medium moist râles on cough at right apex to the third rib. Scattered fine moist râles on cough at right apex posteriorly to midway between the spine and angle of the scapula.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces moderately densely infiltrated. The lower border of this infiltration has a sharp convex line, convexity upward. Left apex moderately densely infiltrated. Mediastinal contents normal.

No. 22 (CASE 4082)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	23.8	19.0	26.7	12.08	3.34	27.6	32.7
MAX. INSP.	23.8	20.8	28.8	14.25	5.59	39.3	——
MAX. EXP.	23.8	18.8	25.9	11.06	1.64	14.1	——



TEXT-FIG. 22.

No. 22 (Case 4082).—Male, butcher; age 22 years. Moderately advanced; active. Sputum + ± +, on admission, in course of treatment, and at present.

Onset 13 months ago with cold. Cough and expectoration moderate; slight pain in left side; slight dyspnea. During his stay in the sanatorium his general condition has remained good and his lung condition is apparently much improved.

	kg.
Height 181 cm. Theoretical normal weight	72.5
Present weight	74.5
Patient's idea of normal weight	76.0
Date of highest weight 22 months ago	78.0
" " lowest " 8 " "	73.0

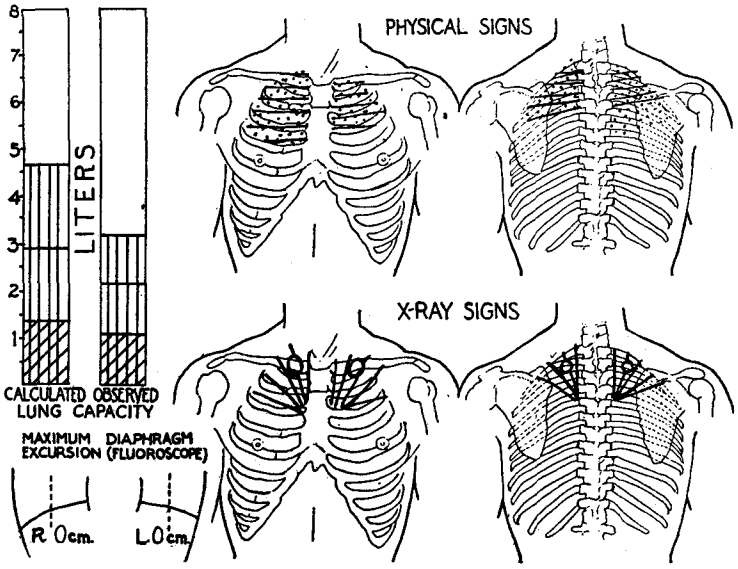
Treatment duration 10 months.

Physical Signs.—April 9, 1917. Dullness of upper part of left lung anteriorly to the fourth rib. No marked change in breath sounds. Coarse râles on cough in left lung both anteriorly and posteriorly to the base.

X-Ray Signs.—April 7, 1917. Right apex moderately densely infiltrated. First and second interspaces slightly stippled. Left apex and first and second interspaces very densely infiltrated. Third and fourth interspaces moderately spotted. Mediastinal contents to the left. Right lung area greatly increased.

No. 23 (CASE 4911)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm	cm.	liters	liters		
REST	18.9	17.4	23.6	7.8	2.1	26.9	27.0
MAX. INSP.	18.9	18.0	24.4	8.3	3.2	38.6	——
MAX. EXP.	18.9	17.1	23.3	7.5	1.1	14.7	——



TEXT-FIG. 23..

No. 23 (Case 4911).—Male, factory worker; age 19 years. Advanced; inactive. Sputum +++, on admission, in course of treatment, and at present.

Onset 17 months ago with symptoms of grippe; began to cough slightly, although weight was not lost. Diagnosis made by sputum examination. Improved rapidly under sanatorium treatment and gained weight. Cough and expectoration markedly diminished.

	kg.
Height 163 cm. Theoretical normal weight	57.0
Present weight	53.0
Patient's idea of normal weight	46.0
Date of highest weight 5 months ago	54.5
" " lowest " 11 " "	45.3

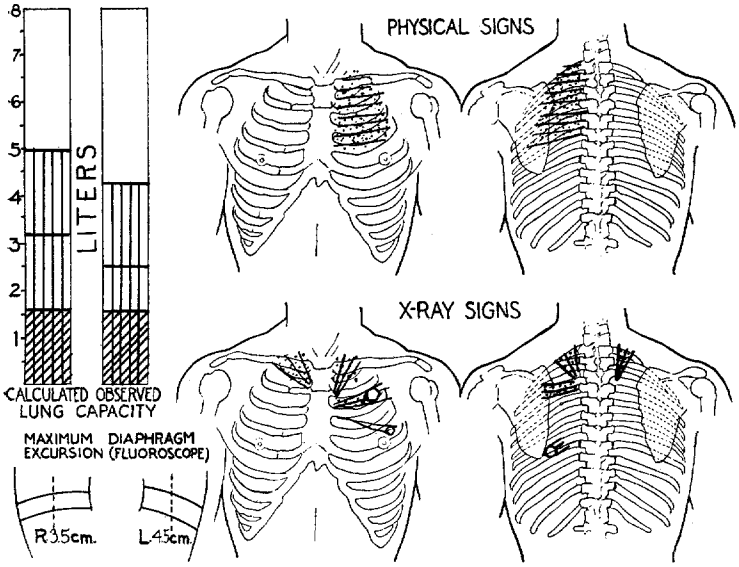
Treatment duration 11 months.

Physical Signs.—April 9, 1917. Right, moderate dullness, very harsh breathing. Numerous râles on cough to top of fourth rib anteriorly, and sixth spine posteriorly. Left, moderate dullness, harsh breathing. Râles on cough to third rib anteriorly, and fourth spine posteriorly. Signs of cavity on both sides anteriorly.

X-Ray Signs.—April 7, 1917. Right apex, cavity 4 cm. in diameter. First and second interspaces densely striated. Left apex, cavity 6 cm. in diameter. First and second interspaces densely infiltrated. Mediastinal contents normally placed.

No 24 (CASE 3334)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	19.5	17.8	24.7	8.6	2.45	28.5	30.3
MAX. INSP.	19.5	18.3	25.2	9.0	4.20	46.7	——
MAX. EXP.	19.5	17.6	24.4	8.4	1.56	18.5	——



TEXT-FIG. 24.

No. 24 (Case 3334).—Male, student; age 16 years. Advanced; inactive. Sputum + + +, on admission, in course of treatment, and at present.

Onset 44 months ago with an acute cold, cough, and fever, soon followed by night sweats. On admission 32 months ago improved rapidly in general condition and weight, and is now with minimum cough and expectoration and in excellent general condition.

	kg.
Height 165 cm. Theoretical normal weight	59.0
Present weight	63.0
Patient's idea of normal weight	59.0
Date of highest weight 29 months ago	63.5
" " lowest " 3 years "	52.0

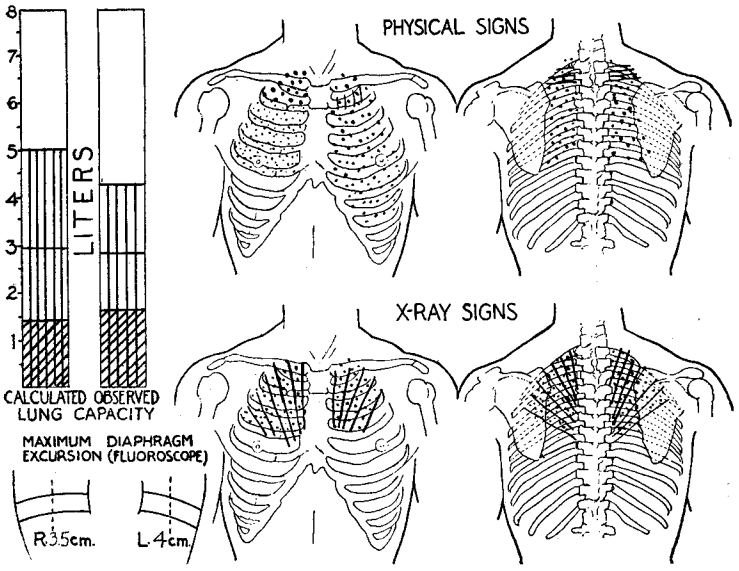
Treatment duration 32 months.

Physical Signs.—April 9, 1917. Right lung clear. Left, moderate dullness, slight harsh breathing, and numerous fine râles on cough anteriorly to fourth rib and posteriorly to sixth spine.

X-Ray Signs.—April 7, 1917. Right apex very slightly stippled Left apex densely stippled and striated. Second interspace densely infiltrated and stippled, with cavity 3 by 2 cm. In the fourth interspace is a very small cavity the size of a bean. Mediastinal contents normally placed.

No. 25 (CASE 4300)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	19.2	17.0	24.5	8.0	2.86	35.8	33.7
MAX. INSP.	19.2	18.2	26.0	9.1	4.31	47.4	——
MAX. EXP.	19.2	16.3	24.3	7.6	1.61	21.2	——



TEXT-FIG. 25.

No. 25 (Case 4300).—Male, machinist; age 23 years. Advanced; active. Sputum + + +, on admission, in course of treatment, and at present.

Onset 17 months ago with malaise, weakness, and loss of 9 kg. in weight. Later severe cough, moderate expectoration, and night sweats. Fever, 100–101° F. During his stay in the sanatorium the fever has subsided and cough improved; no change otherwise.

	kg.
Height 173 cm. Theoretical normal weight	66.5
Present weight	52.0
Patient's idea of normal weight	58.0
Date of highest weight 21 months ago	59.0
" " lowest " 10 " "	47.5

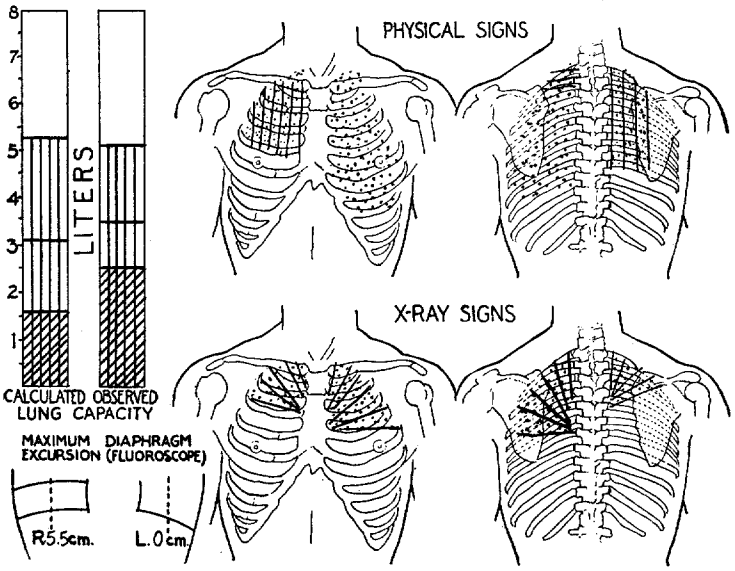
Treatment duration 3 months.

Physical Signs.—April 9, 1917. Anteriorly slight dullness in the first interspace on the left side Dullness at both apices posteriorly. The breath sounds are increased at the right apex anteriorly and posteriorly. Coarse râles on cough at right apex to the second rib; below this fine râles to the fifth rib. Posteriorly coarse râles at upper part of right lung to the angle of the scapula. Coarse râles on cough in left lung to the base anteriorly and to the angle of the scapula posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first interspace densely infiltrated. Second and third interspaces slightly infiltrated and spotted. Rest of lung normal. Left apex and first, second, and third interspaces densely infiltrated and spotted. Mediastinal contents centrally placed. Trachea a little to the right.

No. 26 (CASE 4127)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	18.6	17.0	27.4	8.66	3.45	39.7	30.1
MAX. INSP.	18.6	17.9	29.1	9.67	5.10	52.8	——
MAX. EXP.	18.6	16.4	27.0	8.23	2.50	30.4	——



TEXT-FIG. 26.

No. 26 (Case 4127).—Male, customs inspector; age 24 years. Advanced; active. Sputum + ± −, on admission, in course of treatment, and at present.

Onset 37 months ago with slight cough and expectoration. Loss of 3 kg. in weight. Sputum blood-streaked. His general condition during his hospital stay has remained good. He has had several slight hemoptyses. His lung condition apparently is unchanged.

	kg.
Height 168 cm. Theoretical normal weight	63.0
Present weight	61.0
Patient's idea of normal weight	60.0
Date of highest weight 12 months ago	65.5
" " lowest " 18 " "	56.5

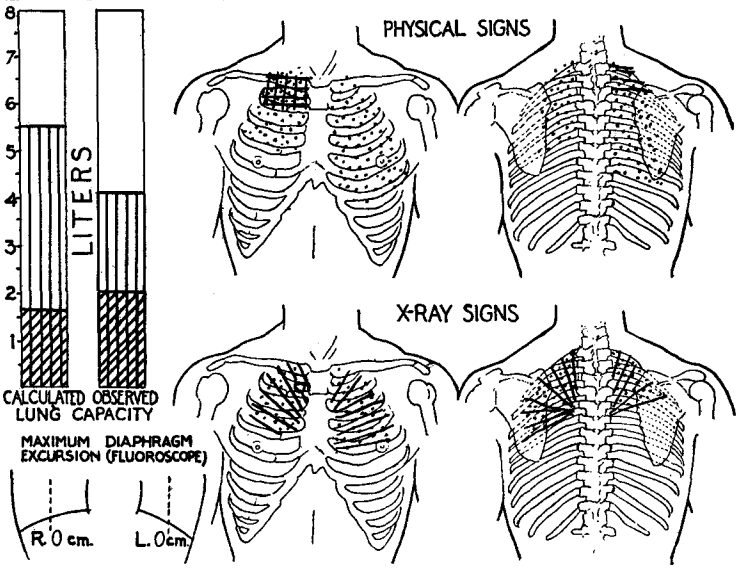
Treatment duration 8 months.

Physical Signs.—April 9, 1917. Slight dullness over right lung, anteriorly to the fourth rib and posteriorly to the angle of the scapula. Dullness at left apex anteriorly. Harsh breath sounds at right apex. Slightly increased breath sounds at left apex posteriorly. Fine moist râles on cough at upper part of right lung to the third rib anteriorly and to the angle of the scapula posteriorly. Medium moist râles on cough in left lung to the base, both anteriorly and posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces moderately densely infiltrated. Left apex and first, second, and third interspaces quite densely stippled and infiltrated. Mediastinal contents are entirely to the left. Right lung area much increased.

No. 27 (CASE 4317)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	20.0	17.0	27.2	9.25	—	—	22.7
MAX. INSP.	20.0	17.5	28.6	10.04	4.15	41.3	——
MAX. EXP.	20.0	16.7	26.2	8.75	2.05	23.4	——



TEXT-FIG. 27.

No. 27 (Case 4317).—Male, laborer; age 23 years. Advanced; active. Sputum + + +, on admission, in course of treatment, and at present.

Onset 12 months ago with severe cough. Later fever and chills. Slight pain in chest. Tendency to tire easily. His general condition has remained poor under sanatorium treatment with the lung condition progressive.

	kg.
Height 178 cm. Theoretical normal weight	70.5
Present weight	59.0
Patient's idea of normal weight	71.5
Date of highest weight 11 months ago	71.5
" " lowest " 8 " "	57.5

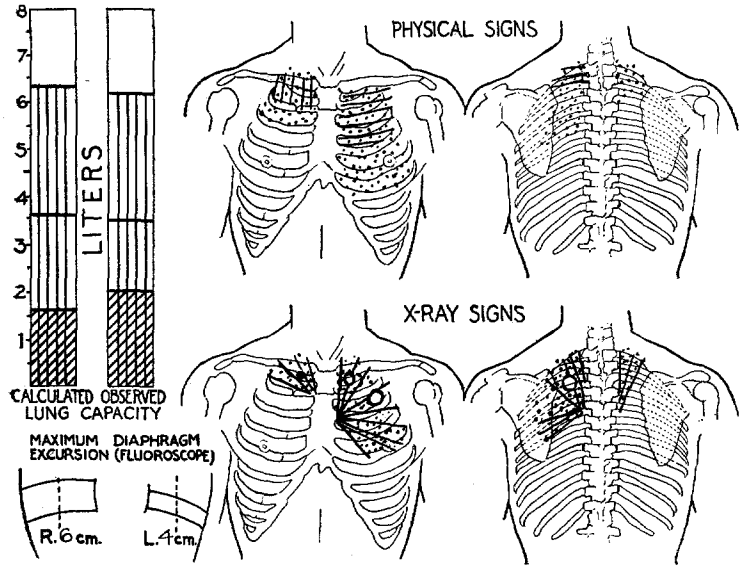
Treatment duration 3 months.

Physical Signs.—April 9, 1917. Marked dullness at right apex to the second rib. Moderate dullness at right apex posteriorly. Harsh breath at right apex to the second rib. Increased breath sounds at left apex to the third rib. Breath sounds increased at both apices posteriorly. Medium moist râles on cough in right lung from apex to fourth rib anteriorly, and from apex to below the angle of the scapula posteriorly. Medium moist râles on cough at left apex to the second rib anteriorly; below this fine râles to the base. Posteriorly medium moist râles on cough from the apex to an inch above the angle of the scapula.

X-Ray Signs.—April 7, 1917. Right apex perfectly clear. First, second, and third interspaces densely infiltrated. The apex may be excavated, but does not give physical signs of cavity. There is a small cavity 1 cm. in diameter at the inner end of the first interspace. Left apex and first and second interspaces densely infiltrated and spotted. Third and fourth interspaces slightly infiltrated and spotted. Mediastinal contents normally placed.

No. 28 (CASE 4346)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	19.9	18.3	26.5	9.65	3.5	36.2	44.1
MAX. INSP.	19.9	18.7	28.5	11.60	6.2	53.5	——
MAX. EXP.	19.9	17.1	25.3	8.60	2.0	23.3	——



TEXT-FIG. 28.

No. 28 (Case 4346).—Male, pattern maker; age 31 years. Advanced; inactive. Sputum + on admission.

Onset 31 months ago with fever, chills, and night sweats. Cough and expectoration moderate. Rectal fistula. Anorexia, hoarseness, and return of fever 5 months ago. Loss of 4.5 kg. in weight since. During his stay in the hospital his general condition has been unchanged and his lung condition about the same.

	kg.
Height 174 cm. Theoretical normal weight	69.0
Present weight	61.5
Patient's idea of normal weight	62.5
Date of highest weight 14 months ago	67.0
" " lowest " 1 month "	58.0

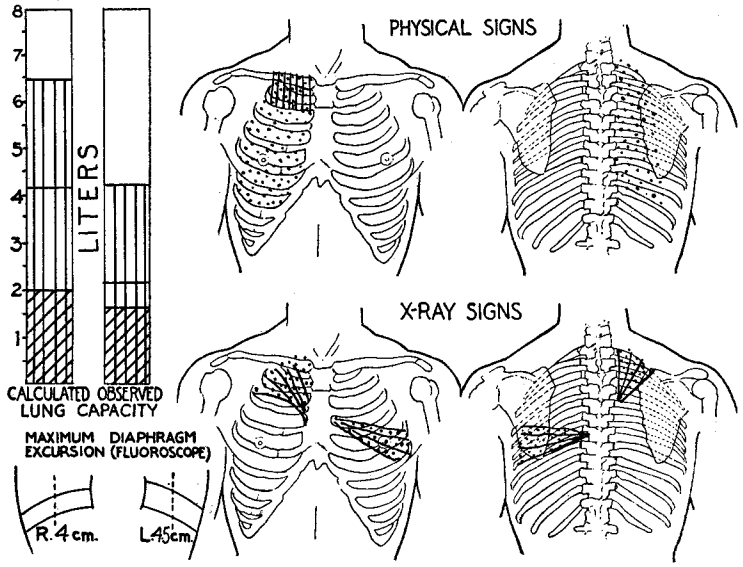
Treatment duration 1 month.

Physical Signs.—April 9, 1917. Slight dullness at right apex to the second rib. Dullness at upper part of left lung from the second to the fourth ribs. Left apex dull posteriorly. The breath sounds are increased from the clavicle to the fourth rib on the left side. Medium moist râles on cough at the right apex to the third rib. Medium moist râles on cough at the right apex posteriorly. Medium moist râles on cough from the clavicle to the sixth rib on the left side, and posteriorly from the apex to a point midway between the spine and angle of the scapula.

X-Ray Signs.—April 7, 1917. Right, moderate infiltration, spotting, and striation of the apex and first interspace. Left, moderate spotting and striation of the apex. Slight spotting of the first interspace. Dense spotting in the second interspace; cavity 3 by 5 cm. in the outer half. Third interspace moderately spotted and striated. Fourth interspace densely spotted and striated. Small cavity under clavicle. Mediastinal contents markedly to the left. Right lung area greatly increased.

No. 29 (CASE 3952)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT. POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	21.3	19.3	27.2	11.2	2.14	19.1	23.2
MAX. INSP.	21.3	19.6	28.2	11.8	4.24	35.9	——
MAX. EXP.	21.3	18.7	26.4	10.5	1.64	15.6	——



TEXT-FIG. 29.

No. 29 (Case 3952).—Male, jeweler; age 20 years. Advanced; inactive. Sputum + + +, on admission, in course of treatment, and at present.

Onset 16 months ago with cough; severe from the beginning and unaccompanied by other symptoms except slight expectoration later. His general condition under sanatorium treatment has remained good; lung disease increased.

	kg.
Height 174 cm. Theoretical normal weight	66.0
Present weight	77.0
Patient's idea of normal weight	68.0
Date of highest weight 4 months ago	78.0
" " lowest " 18 " "	68.0

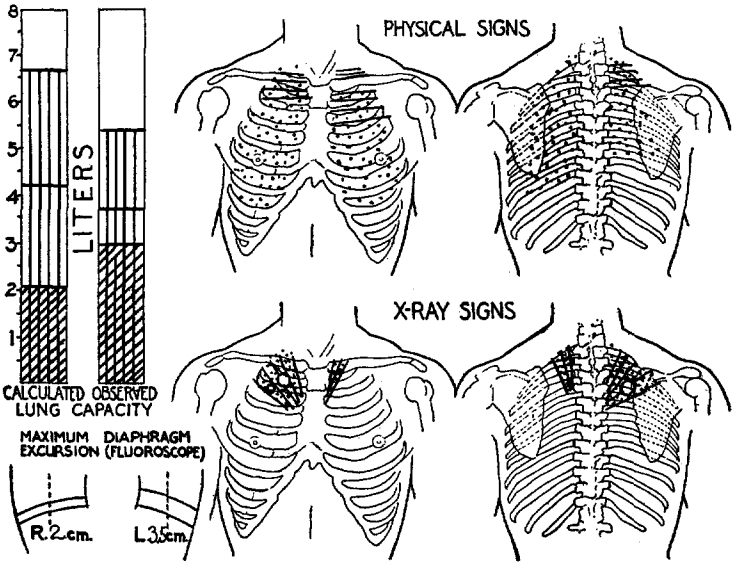
Treatment duration 12 months.

Physical Signs.—April 9, 1917. Impaired resonance on percussion over the right apex anteriorly to the second rib. Diminished breath sounds over the entire left lung, anteriorly and posteriorly. Coarse râles on cough in right lung anteriorly from apex to base. Posteriorly fine râles on cough from apex to angle of scapula. Coarse râles on cough in left lung from the clavicle above to the sixth rib below. None heard posteriorly.

X-Rays Signs.—April 7, 1917. Right apex and first and second interspaces moderately densely infiltrated. Left, fifth and sixth interspaces moderately densely infiltrated. Mediastinal contents normal.

No. 30 (CASE 4027)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT.-POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	21.4	20.2	26.0	11.55	3.7	32.1	21.2
MAX. INSP.	21.4	20.6	27.4	12.10	5.4	44.6	——
MAX. EXP.	21.4	19.9	25.7	11.00	3.0	27.3	——



TEXT-FIG. 30.

No. 30 (Case 4027).—Male, farmer; age 27 years. Advanced; active. Sputum + + +, on admission, in course of treatment, and at present.

Onset 24 months ago with cough. Expectoration began 7 months later. Several small hemoptyses; moderate dyspnea. General condition bettered by sanatorium treatment; lung condition slightly progressive.

	kg.
Height 179 cm. Theoretical normal weight	74.5
Present weight	66.0
Patient's idea of normal weight	65.5
Date of highest weight 5 months ago	68.0
" " lowest " 20 " "	61.0

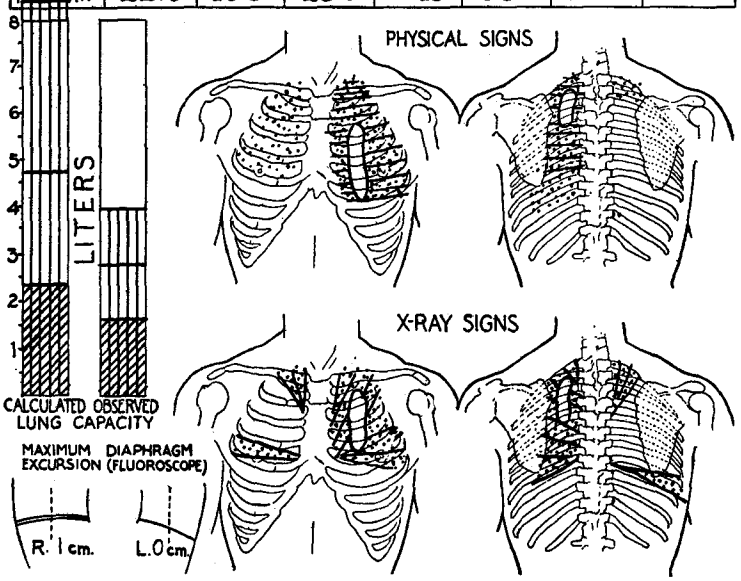
Treatment duration 11 months.

Physical Signs.—April 9, 1917. Moderate dullness over right apex anteriorly to the second rib, posteriorly to the spine. Moderate dullness over left lung anteriorly to the third rib; posteriorly no marked change. Breath sounds of upper part of right lung harsh at apex, bronchial in second interspace. Breath sounds increased in upper part of left lung to the third rib anteriorly. Coarse râles on cough in right lung to base anteriorly; posteriorly medium râles on cough from apex to angle of scapula. Medium râles on cough in left lung from clavicle above to the base; posteriorly fine râles on cough from apex to an inch below the angle of the scapula.

X-Ray Signs.—April 7, 1917. Right apex and first, second, and third interspaces very densely spotted and infiltrated. Moderate sized cavity in the first interspace. Left apex is moderately spotted. Mediastinal contents are normal.

No. 31 (CASE 4130)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY	RATIO 100 X LUNG CAP. / CHEST VOL.	RATIO 100 X VITAL CAP. / CHEST VOL.
	STERNUM	ANT. POST.	TRANSVERSE	"CHEST VOLUME"			
	cm.	cm.	cm.	liters	liters		
REST	22.0	19.7	29.3	12.70	2.82	22.2	18.9
MAX. INSP.	22.0	23.0	30.6	15.50	4.02	25.9	——
MAX. EXP.	22.0	19.3	28.6	12.15	1.62	13.3	——



TEXT-FIG. 31.

No. 31 (Case 4130).—Male, sheet metal worker; age 25 years. Advanced; active. Sputum + + +, on admission, in course of treatment, and at present.

Onset 16 months ago with cold. Cough moderate; expectoration profuse; slight loss in weight; later chills and afternoon temperature of 100° F. Has been continuously toxic during stay in sanatorium; lung lesion progressive.

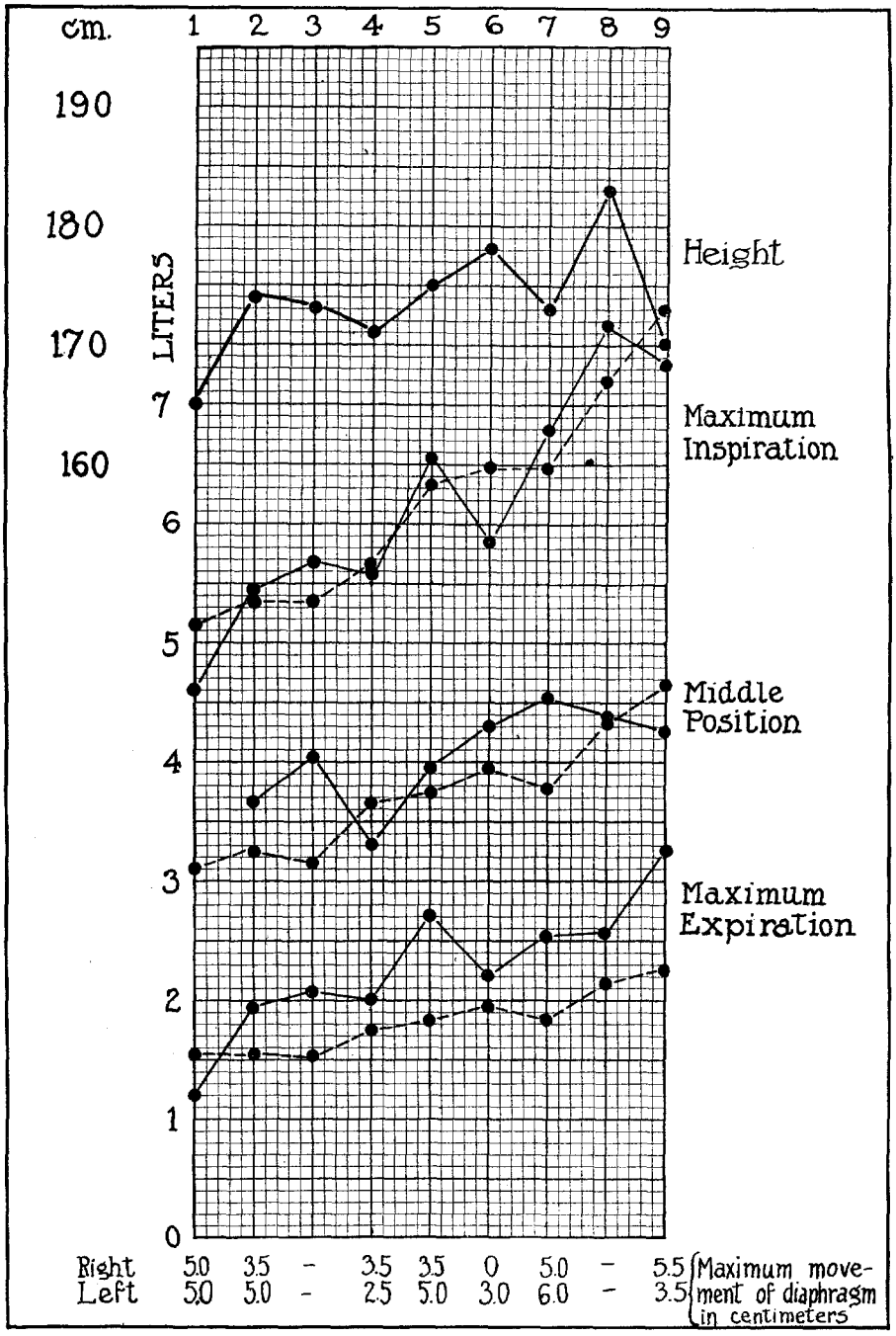
	kg.
Height 177 cm. Theoretical normal weight	68.5
Present weight	?
Patient's idea of normal weight	72.5
Date of highest weight 4 to 5 years ago	76.0
" " lowest " 12 months "	66.5

Treatment duration 8 months.

Physical Signs.—April 9. 1917. Dullness anteriorly over the left lung from apex to the sixth rib. Cracked pot percussion in the second, third, fourth, and fifth interspaces. Dullness posteriorly over the left lung from the apex to the angle of the scapula. Breath sounds harsh posteriorly at right apex. No great change in right lung anteriorly. Diminished breath sounds in left lung posterior to base. Anteriorly slightly increased at left apex, cavernous in the third, fourth, and fifth interspaces.

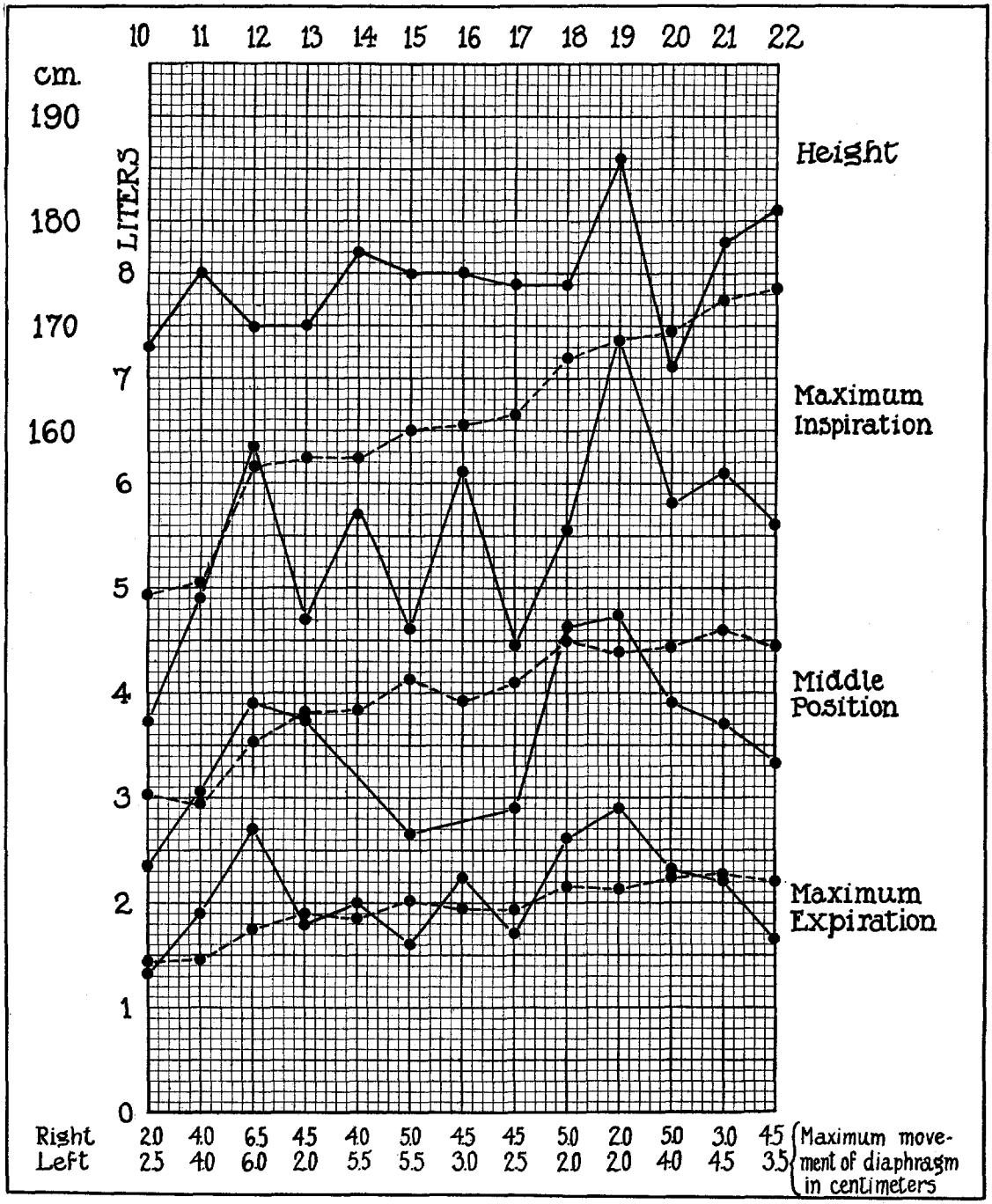
Râles: Right apex to second rib on cough medium moist râles, second to fourth sibilant. Posteriorly medium moist on cough from apex to the spine of the scapula. Fine and medium moist râles on cough in left lung anteriorly and posteriorly from apex to base.

X-Ray Signs.—April 7, 1917. Right apex and first interspace moderately densely infiltrated. Fourth interspace moderately densely infiltrated. Entire left lung densely spotted. Large cavity, 14 by 5 cm. Mediastinal contents markedly to the left. Right lung area greatly increased.

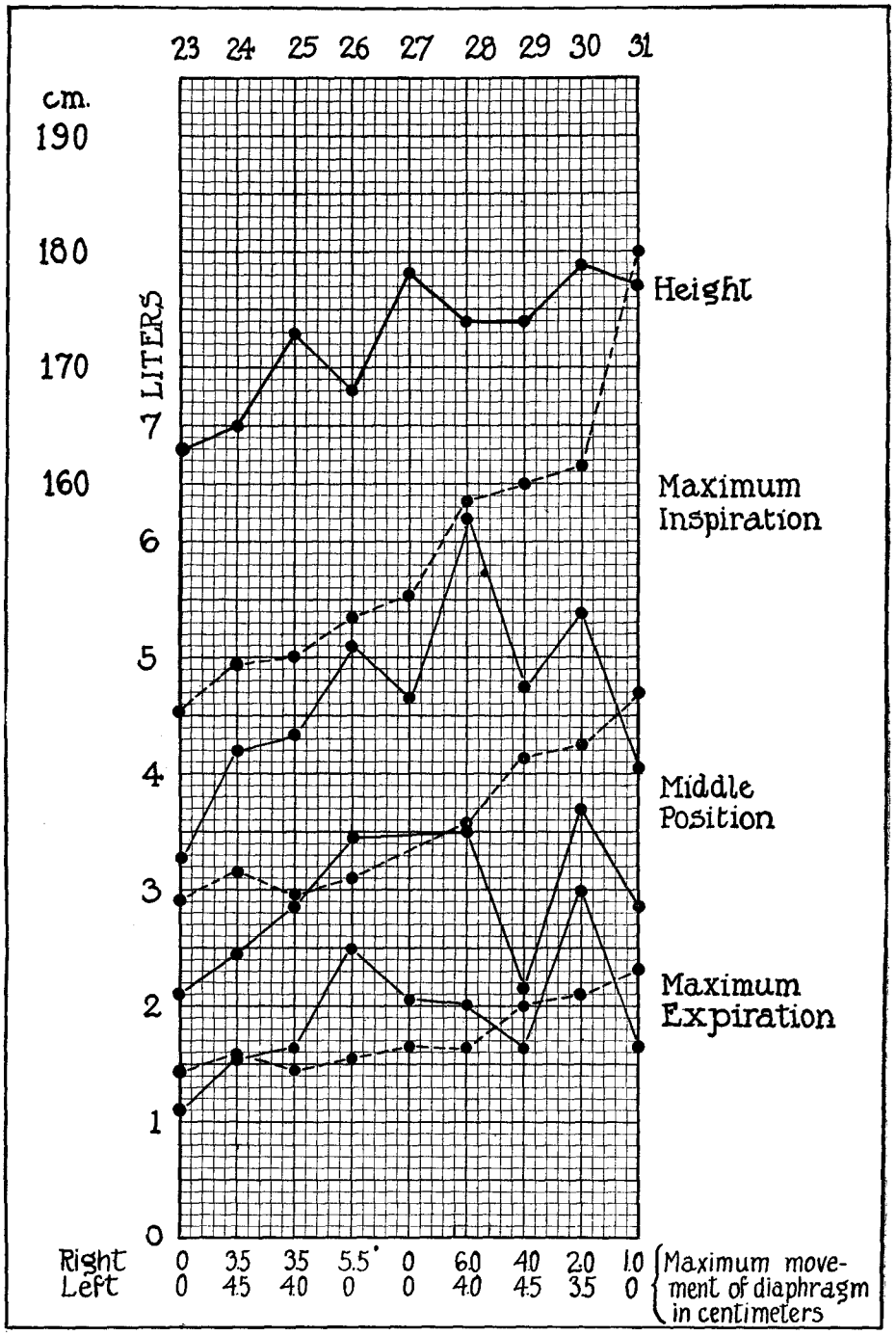


In the charts the numbers below indicate the maximum excursion of the right and left diaphragm. The numbers above the chart refer to the individual diagrams and descriptions (Text-figs. 1 to 31).

TEXT-FIG. 32. Lung volumes in men with incipient pulmonary tuberculosis as determined (solid lines) and calculated (broken lines) from thoracic measurements.



TEXT-FIG. 33. Lung volumes in men with moderately advanced pulmonary tuberculosis as determined (solid lines) and calculated (broken lines) from thoracic measurements.



TEXT-FIG. 34. Lung volumes in men with advanced pulmonary tuberculosis as determined (solid lines) and calculated (broken lines) from thoracic measurements.